Concrete

Vol. 23 Detroit, November, 1923 No. 5

New Cements and Old, and What We May Do With Them

"QUICK-HARDENING CEMENT" which is the subject of an interesting article contributed to this issue of CONCRETE by Edwin C. Eckel is the title of a thoughtful editorial in the October issue of *Concrete and Constructional Engineering* of London, quoted in full on the following page. Our British contemporary concludes that it is "not without value to the user of portland cement that the appearance of a rival cement in the market may stimulate research and possibly lead to the production of portland cement with quick-hardening qualities."

The user of cement is not much concerned about the name of the product nor will he be inclined to split hairs on a definition. The name portland means little and it means much. It started out with a capital P and is still so distinguished in the pages of the technical press abroad. It claimed the capital P because the originator found that his product had the color of a well known natural rock found near Portland on the Dorsetshire coast. In that respect, the name means very little and the capitalization has been dropped very generally in America, as it has from india rubber, paris green and brussels sprouts.

In another respect the word portland, modifying cement, means a great deal. It means a great many millions of dollars invested in promoting its use in making concrete. It means so much, as pertaining to concrete, that in the American Concrete Institute's definition-making committee an effort to define concrete broadly, without defining the binding agent specifically as portland cement, has met with energetic opposition. The users of concrete are interested in cement in terms of results, basically in the same results sought when efforts were first made to produce it—the quality of hardening under water and gaining strength in the presence of moisture. It is a stretch of the imagination to suppose that concrete will not still be concrete when *ciment fondu*, "electric cement," or "alumina cement," or some other such cement is used for a binder. What's in a name?

But to dismiss the name portland lightly is no easy thing to do. Nor is the matter of the tremendous investment made by cement producers directly and by cement users rather incidentally, in advertising the word, to be dismissed lightly.

Next year we shall celebrate 100 years of portland cement. Out of cement chaos a standard has emerged. In standardizing, the cement producers have unified their efforts. Unified effort, as through the Portland Cement Association, has given us confidence in the product; that same unified effort has speeded our education in *how* to use portland cement. Knowing how has caused us to use more and more of it. That is the legitimate objective of the producer. That, too, is the users' gain. Real progress can only be through the mutual satisfaction of buyer and seller. Poor as our portland cement standards are, winking at a 100 per cent variation in strength in 28-day tests, it is not to be wondered that the cement producers view with some apprehension the increasing interest in a new kind of cement which may soon have us all by the ears in upsetting whatever complacence has been ours about our present cement standards.

We must always stand for progress. We can't refuse a new thing consideration because it causes us some inconvenience in upsetting our routine. Perhaps, though, the editor of *Concrete and Constructional Engineering* has suggested a way out of the difficulty. The appearance of a rival cement "may stimulate research and possibly lead to the production of Portland cement with quick-hardening qualities."

* * *

There is in this whole matter of new and better cements another angle of thought. Construction engineers are as yet a long way from the best use of such cements as we now have. Concrete, so inconsiderately abused in the making, serves better perhaps than the builders deserve.

As long as we mix our cement with dirty aggregate and with poorly graded aggregate and with more aggregate than a given amount of cement will cover, and then slush the whole mix with so much water as to sacrifice more than half the binding quality of the cement, we can't in very good conscience upbraid the producers for not giving us something better to abuse. You can't justly blame the doctor for failing in a cure if you don't take his medicine as prescribed.

Quick-Hardening Cement

An Editorial from *Concrete and Constructional Engineering*, London, England.

THE advent of the new aluminous cement referred to in our August issue has stimulated interest in the possibility of improving the quick-hardening properties of Portland cement. There is no doubt that cement users would gladly adopt a quick-hardening Portland cement in preference to a new cement if the hardening properties could be improved to some degree approaching the latter.

A good deal has been done in recent years by refinements in manufacture, such as fine grinding of raw materials and finished cement, to improve the strength of Portland cement at ages of twenty-four and forty-eight hours, the strengths at these early periods being improved in about the same proportion as the recognised 7-day tests have been improved. But there is still room for further improvement, which would be welcomed by builders and contractors whose operations would be greatly assisted if concrete attained in, say, twenty-four hours the strength usually developed in seven days. Portland cement manufacturers will doubtless be alive to the importance of this matter, and will spare no effort to develop the qualities of cement in this direction. It must be admitted that the British Standard Specification is almost a deterrent to such an improvement, because of the growth in strength that is demanded for neat briquettes between the ages of seven and twenty-eight days.

The strength of Portland cement is due to the presence of certain definite chemical compounds, and there is probably a definite limit to the tensile and compressive strengths that cement may develop. If by fine grinding the strength is developed at an early period it is irrational to demand any substantial increase at later dates, especially in the case of neat cements. The British Standard Specification recognizes this to some extent by the use of a formula which reduces the required growth from seven to twenty-eight days as the 7-day test increases; but the allowance is not sufficiently effective, and with the personal element in testing tending to cause irregularities there are risks when efforts are made to produce additional strength at early dates that the balance of the strength available in the neat cement will not suffice to yield the increase demanded by the Standard Specification. It must be remembered that the Specification by its stringent tests for soundness and chemical composition already provides safeguards for the ultimate stability of the cement so that a cement which otherwise complies with the Specification cannot be classed as unreliable if the neat test fails to show the specified increase at twenty-eight days. Hence, as we have already stated, the British Standard Specification is in some degree a deterrent to the development of quick-hardening cements.

In addition, however, to the measure of quick-hardening properties that can be developed by refinements in manufacture there are the same qualities possessed in a superlative degree by some cements as a result of chemical composition. It is known that cements in which the chemical analysis shows the proportion of alumina to be 2 or 3 per cent above the average are usually considerably better—other conditions being equal—in their early hardening properties than the average cement. Some brands have gained a high reputation among users as the result of their high alumina content endowing the cement with quick-hardening properties. Such cements are seldom if ever the subject of complaint of delayed hardening or failure to set. It is a striking fact that the orthodox Specification tests do not reveal any superiority in quality, and at seven days the tensile and compressive strengths of such quick-hardening Portland cements are no better than the average cement. This has often been a cause of mystification to the user of cement, who observes that while the Specification tests of two cements may be similar yet one cement may "harden off" much more rapidly than another, and the impression left on the minds of the uninitiated is that tests are of little value.

In the great majority of cases the cement manufacturer is unable to increase the proportion of alumina in his cement at will. The proportion of alumina in the raw materials is usually practically constant in any one deposit, and there is no possibility of increasing this constituent other than by transport of a special raw material at prohibitive cost. It is therefore not without value to the user of Portland cement that the appearance of a rival cement in the market may stimulate research and possibly lead to the production of Portland cement with quick-hardening qualities.

* * *

The Business Outlook

OF the business outlook, *The Wall Street Journal*, October 23, has this to say:

Two opposite opinions regarding the business outlook seem to be prevalent. However, if only a few of the basic facts be examined it will be found that the outlook is good as far ahead as one can judge. An unduly rapid pace is not to be desired. A steady, healthy condition like the present means more in the long run.

Most pessimistic arguments seem based on a comparison with the earlier months of the year. The fact is overlooked, however, that this is like comparing a high level with a peak and then complaining that the former is low. The Federal Reserve index of production of the basic industries shows that between January and May the volume was higher than ever before attained.

The index in May was 127 compared with 92 in May, 1922, 77 in 1921 and 105 in 1920. The latest available figures of production in the Federal Reserve Index cover August. These show that production at that time was only 6.5% below the peak in May of this year. Considering that May was so very high, this is not an alarming drop. It looks still better also when compared with August, 1922, which was 21.6% smaller.

Production now is about one-fifth greater than a year ago. There is no pessimism in such a figure. Another important fact is that goods are going into distribution. The proof of this is in the large volume of railroad freight loadings. The loadings in the first week in October showed a small drop, but the volume still is great.

The Fisher Weekly Index shows that prices are about 7% below the peak of the April average. They are also that much higher than a year ago. Week by week also for some months back the price list has been stable. Employment is only a little below that of the peak of this year, when production was at its highest, and it is considerably larger than last year, while wages for the year seem to be stable and at their highest.

Building is below the peak of the year, but this is only seasonal. Building permits issued in 152 cities in September were 10% larger than last year. The steel corporation is still running about 85% of capacity and at that rate has enough business on its books to last more than four months.

It is not desirable for production to run at fever rate as it appeared to be last spring. The present condition, while somewhat slower, is still more satisfactory in every way.

The Actual Uses of Alumina Cements

First Article

By Edwin C. Eckel

Portland cement, long the most important of our structural materials, was invented almost a century ago; its centennial will perhaps be celebrated in a year or so. But long before that celebration, Alumina cement of American manufacture will be on the market in important tonnages; and from next Spring onward we may fairly expect one of these unpleasant periods such as we passed through during the portland-slag and the portland-natural controversies. In such inter-family cat-fights each interest is tempted to make claims for its product which are perhaps a bit exaggerated; and each side is tempted to attack the other with "expert" testimony of the type which, during an anti-trust suit, escapes being perjury merely because the "expert" is looked upon as a chartered libertine who is legally incapable of committing that crime.

Under these circumstances, it will be well to examine claims and counter-claims with more care than usual; and wherever possible to subject them to the test of a personal examination or investigation. As a first step in this direction, I have prepared the present statement of the chief actual utilizations of the new cement in Europe. This statement is one of fact, and not in any sense an argument; I am about to give names and addresses of the engineers who have actually used Alumina cement, so that anyone who is sufficiently interested may find out exactly what luck, good or bad, has attended such use.

In order that all the cards may be on the table it is well to state that I have been acquainted with the actual manufacture and use of the Alumina cements for a little over five years, having first encountered them when in charge of one of the Lafarge mills during part of the war. Since then I have studied the subject with increasing interest, and this year was able to make a reinvestigation of the entire matter, from mill to market. I am responsible, to some extent, for the fact that their manufacture has been taken up by important interests here and in British possessions; and for the fact that Alumina cement of purely American manufacture will be on the market in adequate quantities early in 1924.

To the extent that I have just stated, my ideas about the importance of the new cement may be prejudiced; and I have stated my relation to the affair frankly and completely so that the reader may allow for just this possible prejudice. But there is after all, little opportunity for error of judgment, intentional or not, in the simple statement of facts that I purpose here.

It remains only to add that I have, with few exceptions, drawn my examples of utilizations of Alumina cement from works executed with the brand made by the Lafarge company. There are two reasons for this: one is that Lafarge is still the largest producer in the world of the new cement; the other is that the officials of the Lafarge company have placed material at my disposal with far less limitations than have some of their competitors. I am sorry that this public acknowledgment cannot do the Lafarge company some commercial good; but their possible output is already heavily oversold. In order to accommodate some of my engineering acquaintances I have tried to secure prompt shipments of Alumina cement from the other side, but it is a frank impossibility.

The Alumina cements have been used in two widely different fields, each employing primarily one of its two exceptional qualities. One of these is its resistance to chemical attack; the other is the great rapidity with which it attains maximum strength. In the present discussion I will first consider those uses in which resistance to chemical attack is the matter of prime importance.

Use of Alumina Cement Against Alkali Waters

This is the original use to which the new cement was put, and our records with regard to it are consequently very long and complete. Over 15 years ago the Paris-Lyon-Mediterraneé Railroad, which is one of the most important in Europe both financially and technically, found difficulty in its works along the Nice-Coni line and elsewhere. The rocks here include many beds of gypsum and anhydrite, and the waters percolating through these rocks picked up heavy charges of salts in solution. These attacked the masonry of tunnels, culverts and bridges; and caused rapid failure of structures built with portland and other cements which had proved perfectly good in easier situations.

Bied worked out these low-index Alumina cements to fit this particular trouble, and solved the difficulty perfectly. The railroad has carried on tests on a large scale for over ten years; it no longer uses portland cement "in any dangerous or exposed situation"—which alone is a compressed and caustic summary of the case—and it does use the Lafarge ciment fondu and that alone in works in these alkali-water regions. The tunnel at Braus took some 75,000 bbls. Similar results have been attained in the North African lines, where similar difficulties appeared when portland cement was still in use. Today that particular question is settled, so far as French engineers are concerned.

Any American engineer wishing to make sure of these facts can doubtless get all the data he desires by taking the matter up with M. Sejourné, Chief of Construction, P. L. M. Railroad, 88 Rue St. Lazare, Paris. All that should be required will be a letter, couched in terms a little more courteous than is common in American business-college language—and perhaps a French stamp or two.

Use of Alumina Cement Against Sea-Waters

The second use to which alumina cement was applied abroad arose from the fact that it resists sea-water better than does portland. The fact that this particular use has not greatly increased is due, not to any technical defects of the new cement, but to cold commercial considerations peculiar to France. The fact is that the French already had a very good anti-sea-water cement, considerably cheaper than portland and far cheaper than ciment fondu. This is the special hydraulic lime made, also by Lafarge, for marine work; it has been used successfully for decades by the French government engineers at all the Mediteranean ports. There was no particular reason to force the new alumina cement into a field which was already occupied satisfactorily at a lower cost. So that the spread of alumina cement *in France* will probably always be limited along this particular line. In the United States, where no one has ever made a good hydraulic lime, the field is still open—until next Spring.

Nevertheless, even though there was little commercial inducement to push ciment fondu into marine construction, it has been so used successfully, where the importance of the work seemed to justify the extra cost. Three examples, differing sharply in local conditions, may be profitably cited:

(1) At the fishing port of Lorient, on the Atlantic, exposed to severe storms as well as normal erosion, ciment fondu was employed by M. Verriere, Chief Engineer of Ponts et Chausses.

(2) At Pauillac on the Gironde estuary, M. Gallois of Bordeaux used ciment fondu. Here it also encounters Atlantic water, but without the serious storm effect which the Channel and Breton ports have to resist.

(3) At Mers-el-Kebir, on the Algerian coast, M. Vaisset of Oran put in work with Alumina cement. Here it encounters Mediterranean water, which carries more salts in solution than does the water of the open Atlantic.

These three examples therefore give tests in actual work under three very different sets of conditions; the only thing that seems to remain would be a test at some open roadstead such as Mollendo or other south Pacific port, where rapid changes in temperature are added to the storm effect and the normal chemical attack.

USE OF ALUMINA CEMENT AGAINST CONCENTRATED ACIDS AND ALKALIES

This is a use which is slowly developing and concerning which little definite can yet be said with certainty. A number of plants engaged in various branches of the chemical industry—among which paper mills may be specified—have tried and are still trying Alumina cement for tank linings, drip boards, etc. In these industries it encounters very difficult conditions, having to resist the more or less prolonged attack of different chemicals. In some of these uses it has succeeded and will have a utility, though of course very limited in tonnage. In others it has failed just as badly as all of its predecessors, portland cement included.

With these data, the reader is now in position to investigate for himself the present status of the Alumina cements with regard to their actual use in sea water, in alkaline water and in chemical plants. These three broad types of utilization are all alike in that the chemical resistance of the Alumina cement is the point of interest. They are also alike in that they are attempts to make a new cement do a difficult thing, almost regardless of cost. There still remains to be considered a widely different class of utilizations, one of far more commercial and technical importance. Reference is made to the use of Alumina cement for certain classes of engineering work because of its quick-hardening properties, which save so much in time, labor and forms that there is an actual economy to the contractor in its use. These will be discussed later.

Composition Flooring

By RAYMOND RENARD BUTLER

(In *Chemistry and Industry*, England)

The chief binding materials used in modern jointless flooring are portland cement, magnesite cement, bitumen, rubber, and hard-burnt plaster of Paris. Of these the last named is little used in this country, but finds more extensive application on the continent under the name of Estrich gips.

The life of a jointless floor depends mainly on the ability of the binding material to resist wear and tear. From the standpoint of the chemist the influences at work upon such floors are both mechanical and chemical:—(a) Attack by iron tires of trolleys, etc. (b) Attack of the flooring on rubber tires. (c) Influence of oil. (d) Influence of water. (e) Influence of acid. (f) General foot traffic. The problems of fireproofing and sound-proofing are also important.

It will be convenient to deal with the subject sectionally.

PORTLAND CEMENT

Olive, whale, bone and wood oils, and tallow show a tendency to attack freshly laid concrete, but concrete one month old is immune. Mineral oils derived from the distillation of coal products are without action on the cement unless contaminated with acidic substances. Even weak acids such as vinegar, sulfurous acid and carbonic acid in large quantities have a destructive effect. Alkalies such as potash and soda have no action, but ammonium salts tend to disrupt the surface, with the liberation of small quantities of ammonia. Organic fertilizers and manures attack lean concrete (*i. e.*, concrete having a low percentage of cement) when freshly laid, but not concrete one month old.

Water is practically without action on the cement, which may be rendered impervious by such substances as bitumen or sodium silicate. Bitumen is frequently used to render cement acid-proof (see "Bituminous Materials and Cement," U. S. Bureau of Standards).

The use of sodium silicate as a top dressing will satisfactorily cure the "dusting" of portland cement, but it should be noted that common viscous "water-glass" is not always satisfactory. Such solutions are usually cloudy and have a soda/silica ratio varying between 1:4 and 2:3. The most generally useful silicate for use on cement has a ratio Na_2O/SiO_2 of 1:3.3. The solution contains 3.3 molecules of silica to 1 of soda and is usually clear. It is now possible to obtain a "neutral" silicate in the form of a white powder, soluble in hot water, and containing about 60% of silica and 20% of soda.

A report on "Service tests on Concrete Floors" has been published by the U. S. Bureau of Standards (October, 1920).

MAGNESITE CEMENTS

Magnesium oxide, prepared by heating magnesite ($MgCO_3$) to 800° C., is mixed with a strong solution of magnesium chloride; and the mixture sets to a hard compact mass having the formula $5MgO.MgCl_2.XH_2O$, where X has the value of 17 approximately. The magnesia should contain between 85 and 90% MgO, and less than 4% CaO (lime). The specific gravity of the $MgCl_2$ solution usually lies between 28° and 30° Bé. The density of most magnesite floorings is about 1.1 (water=1). Such floors should not be washed too frequently. A preliminary dressing of linseed oil, followed by ordinary floor polish, is probably the best treatment.

BITUMEN

Bituminous substances, acid-proof and waterproof, are valuable as viscous binding materials, and are frequently mixed with finely-graded granite dust, limestone dust and cement, in order to increase the viscosity. (See D. C. Broome, *J.*, 1923, May, 192T.) If V=the viscosity of the tar alone at any temperature between 60° F. and 100° F. and V_p=viscosity of the mixture at the same temperature, it is found that $V_p = V^x$, where the value of $X = kp + 1$, p being the percentage of filler added and k a constant whose value is 8.5×10^{-3}. The percentage p of filler added should be less than 15%.

It is possible therefore to calculate with reasonable accuracy the amount of filler which must be added to a low-viscosity tar to raise the viscosity to a given value V_p, since from the equation, $V_p = V^{(Kp+1)}$ and therefore

$$p = \frac{\log \frac{Vp}{V} - 1}{8.5 \times 10^{-3}}$$

The equation should not be used for tars of a consistency V of less than 10 seconds at the temperature of the experiment, and no particles larger in diameter than 0.01 in. should be added. Reference may be made to the "General Directions for Tar Treatment of Roads" (Ministry of Transport, Roads Dept., 1923).

RUBBER

Rubber is resistant to water and acid under general conditions, but is considerably affected by oil. With raw rubber at 8d. to 10d. per lb. it should be possible to put on the market a self-colored rubber ⅛ in. in thickness at 12s. per sq. yd. The present maximum width of such compositions is 48 in. Sheet rubber can be readily trimmed with a wet knife, and joints can be fixed down onto a cement base with rubber solution, or onto wood with glue. The material is eminently suitable for hospitals and institutions where the floor surfaces are washed regularly.

CALCIUM-SULFATE CEMENTS

Hard-burnt plaster of Paris, produced at temperatures above 400° C. sets only very slowly, but the finished product is extremely hard. Experiments made by Haddon (*cf. J.*, 1921, 122T) show that the expansion of plaster of Paris on setting is least when accelerators such as K_2SO_4 or $FeSO_4$ are used, and greatest when retarders (*e. g.*, $CaCl_2$) are employed. The tensile strength of briquettes in which an expansion of 5% has occurred is considerably less than that of a plaster in which expansion is normal, say 0.1%, and has not been influenced by retarders. It is found that mineral oils have no effect on the tensile strength. As flooring compositions, such cements have the disadvantage that they set very slowly.

MISCELLANEOUS CEMENTS

Many modern composition floors consist of mixtures of short fibre asbestos held in a binder of sodium silicate with or without the addition of other aggregates such as powdered serpentine; the colouring matter in such flooring is usually oxide of iron (rouge).

PATENT LITERATURE

One suggestion for sound-proof material (E.P. 110,194, 1916, *J.*, 1917, 1237) involves the production of a porous structure by suitable quantities of sand and portland cement. A fireproof composition is described in E.P. No. 121,986, 1917, and an acid-proof mixture in 212,855, 1918 (*J.* 1919, 107A). Light concretes frequently contain cork dust or sawdust, and sometimes dilute sodium silicate is added; as examples of porous aggregates see E.P. Nos. 173,965, 1920, and 180,887, 1921.

Patent No. 13,075, 1915, describes a magnesite composition, in which magnesia is mixed with 15 to 25% of its weight of sawdust, and 50% of its weight of $MgCl_2$ solution (18° Bé), a facing of slagwood or asbestos being given.

A. A. Shively (*J. Ind. Eng. Chem.*, 1916, 8, 672) recommends the use of a mixture consisting of, per cent, magnesia 40, clay 20, venetian red 12, sawdust 10, terra alba 8, $MgCl_2$ 10, water being added as required; compare also Nos. 15,038, 1914; 120,727, 1917; 162,514, 1920 (*J.*, 1921, 434A) and 178,880, 1920. The use of various zinc oxychloride compounds has been patented, *e.g.*, No. 194,025, 1922 (*J.*, 1923, 403A), in which the final hardened surface is formed by the action of formaldehyde on gelatin. In No. 112,196, 1917 (*J.*, 1918, 89A) it is stated that the double oxychloride has the composition $Zn_2OCl_2.Ca_2OCl_2$.

The stability of bituminous substances is stated to be increased by the admixture of at least 2% of clay paste, the water being removed by evaporation (No. 9838, 1915). Reference may be made to a sound-proof mixture covered by a German patent (329,410, 1918; *J.*, 1921, 220A).

A plastic composition resembling natural asphalt is covered by No. 181,092, 1921, in which one of the constituents is rubber. The addition of 2 parts hydrated aluminium oxide to 1 part of rubber is suggested as a method of rendering rubber "non-flam" (159,014, 1919; *J.*, 1921, 269A), and the same fireproofing effect is claimed for sodium tungstate in a mixture consisting of rubber solution, woody fibre, and sodium tungstate (No. 110,941, 1916). Reference may also be made to No. 107,107, 1916 (*J.*, 1917, 895), and to an American patent which claims that high fusing point and marked colloidal properties are obtained by incorporating 1 to 1.5 parts of rubber and 100 parts of bitumen.

Silicate floorings are represented by No. 183,753, 1921 (*J.*, 1923, 57A), the mixture consisting of quartz 50 pts., shavings 40 pts., zinc oxide 5 pts., potassium silicate solution (30° Bé.) 50 pts. In place of shavings, short fibre asbestos is frequently employed.

An acid-proof composition is covered by No. 108,278, 1917 (*J.*, 1917, 965), which consists of such an admixture as quartz 90 pts., calcium phosphate 10 pts., and sodium silicate 30 pts., to be mixed in the usual way, and treated with an acid such as sulfuric acid either just before or just after it sets.

Evansville College to Make Block Tests Free of Charge

Cooperation of a practical sort has been extended to the concrete products industry and to the city of Evansville, Indiana, by Prof. Max Robinson, in charge of the testing laboratories of Evansville College. That city is about to adopt an ordinance, similar to the one passed in September, 1922, by the city council of Camden, N. J., designed to regulate the manufacture and use of concrete products. As an aid to the city and the building industry, Professor Robinson has offered to undertake the testing of block free of charge. He feels also that as a further result of this arrangement the students will obtain experience in commercial testing.

The block industry in Evansville heretofore has been unregulated, and the product has been of an inferior quality. Although some of the manufacturers appreciated the importance of turning out a product based on quality, they were compelled to compete with back-yard block makers who knew little and cared less about the manufacture of high-grade block. The proposed regulation will therefore be welcomed by the better element among the block manufacturers; while the home builders of Evansville, on their part, will be assured of a high-grade building material made largely by local labor and from local raw material.

If you have a cold weather concreting job on your mind, tell the Editors. Maybe they can get the information you need.

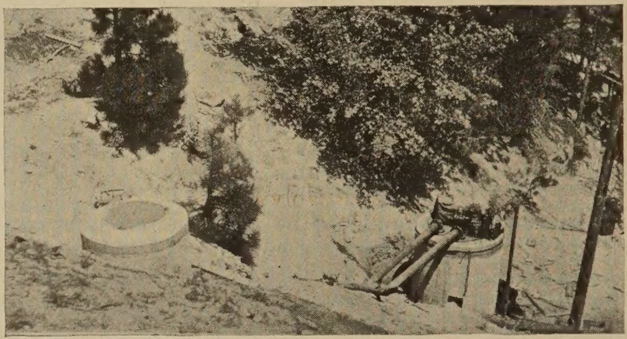
Unique Mountain Sewer System of Concrete Pipe

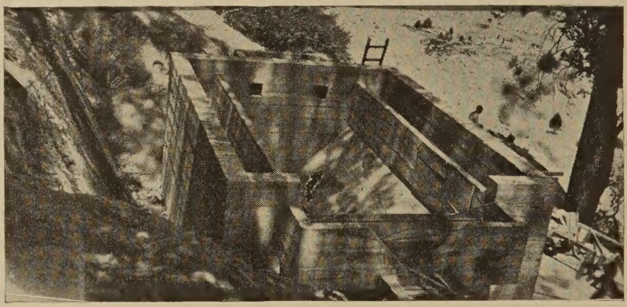
Good concrete roads, good weather, and good automobiles, have made the mountain resorts of Southern California so accessible that they have become overcrowded in the summer time, and the matter of sanitation is becoming a serious problem. To meet this condition a unique type of sewer system has recently been completed by the Arrowhead Lake Co., at Lake Arrowhead, altitude 5100 ft., 15 miles north of San Bernardino, Calif. This resort is fast becoming California's finest mountain playground. The lake is formed by a dam, is some 2½ miles long and ¾ mile wide, and is in the heart of the mountain cedars and pines. Sixteen miles of sewer, using machine-made concrete sewer pipe, were installed on a contour close down to the water line and practically around the entire lake.

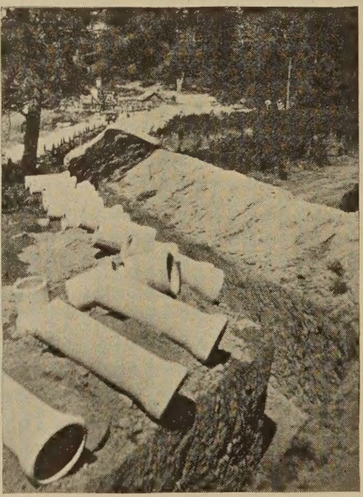
As it is obvious that a sewer line laid parallel to the water's edge would have no grade, the engineers devised the interesting plan of a series of lines about a mile long, the profiles of which look like the teeth of a huge saw. Each line is laid to a grade proper to handle the required amount of sewage, and at the low point of each "saw tooth" line the sewage discharges into a sump, and is automatically pumped up some 15 to 25 ft. into a sump which is connected to the high point of the next "saw tooth" line. The sump arrangement is shown in Fig. 1. These lines continue around the lake until the last line lifts the sewage over one end of the top of the dam and discharges it into a regular Imhoff tank (Fig. 2).

As the pipe line had to be laid on contour lines, excepting for sharp projecting points, and as the contour changes in direction every 25 to 50 ft., the usual plan of establishing manholes at each turn was dispensed with. Accordingly the line is built with curves wherever required to follow the contour as shown in Fig. 3. Special 10° bell and spigot bends 1 ft. long were designed and made for the work, the angle of each turn determining how many of the bends were used. On account of most of the sewer line passing through and close to tree roots, great care was used in making each joint watertight.

The engineers chose concrete sewer pipe for this difficult job; first, because they knew that concrete pipe manufactured to meet modern stringent specifications makes a first class carrier for all normal sanitary sewage; second, because they considered that on account of the tree root menace and the need for the tightest possible joints (a condition existing in every sewer, but particularly in this one), the bond between the cement mortar and concrete pipe which would be tighter and closer than with any other pipe they could use would be most effective; third, because on account of the flatness of the grades, the smoothest possible flow line was demanded and the engineers believed this could be best accomplished by using concrete pipe with its exclusive self-centering shape on the inside of the bell.







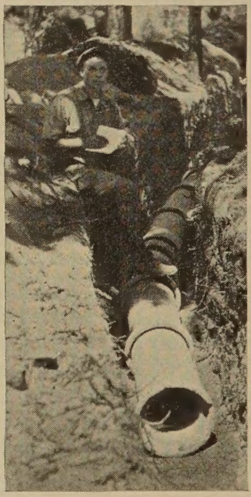
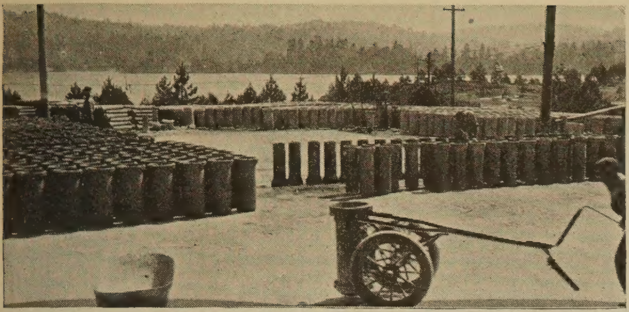
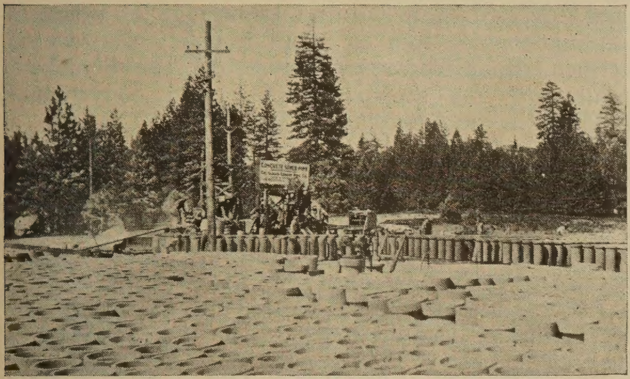
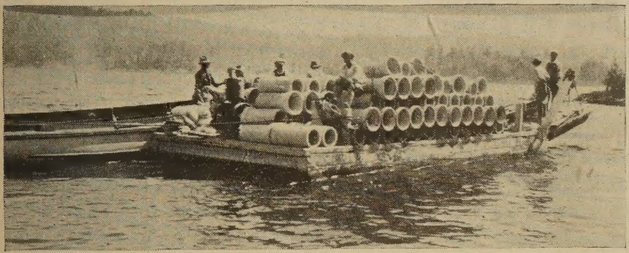


Fig. 1—Sumps and Automatic Pumping Equipment
Fig. 2—Imhoff Tank into Which System Discharges
Fig. 3—Curved Sewer Trench Following Natural Contour
Fig. 4—Turning Angle with Special Bell and Spigot Bends

The firm furnishing the pipe dissembled one of its plants, hauled it up the mountain roads, and re-erected it on a clear level space near the lake, and there manufactured the concrete sewer pipe used for the entire job. A rock crusher and sand rolls were installed, so that the proper amount of very fine and coarse aggregate could be added to the sand found in the canons, and hauled to the plant site. The pipe machine used was the Hammond tamping machine. As construction







Figs. 5-6—Plant and Yard Where Concrete Pipe Were Made Near Site of the Work
Fig. 7—Barge Load of Concrete Pipe Being Towed Across Lake

work was being rushed, the pipe plant operated double shift, turning out the 82,000 ft. of 6-in. to 12-in. pipe in three months. Consistent with good engineering and good manufacturing, every day's run of pipe was tested by the engineers, the specifications being substantially the same as the standard American Society for Testing Materials Specifications for concrete sewer pipe. Following is a resume of the tests:

	HYDROSTATIC TEST			CRUSHING TEST	
Size of pipe	Total ft. manufactured	No. lengths tested	No. failures	No. lengths tested	No. failures
6"	33,000	85	None	30	None
8"	11,000	65	None	65	None
10"	16,000	35	1	40	None
12"	22,000	170	None	173	1

Another unusual feature of this work was the method of transporting the pipe to the trench. The pipe after being aged, tested and accepted by the engineers, were rolled down from the plant to a dock at the waters edge. From there they were loaded onto a barge shown in Fig. 7, and towed across the lake to a point on the shore line immediately below the trench. The pipe were then rolled off the barge on planks and up the hill 20 to 35 ft., to the trench.

The consulting engineers in charge of design and construction of this sewer system, as well as the other developments around Lake Arrowhead, were A. J. Salisbury and Charles Bradshaw and Arthur Taylor. The concrete sewer pipe was manufactured by the Bent Concrete Pipe Co , formerly the California Glazed Cement Pipe Co.

Expansion Joints for Bridge Railing

Expansion details for concrete bridge railings are described by O. W. Gatchell, in *Engineering News-Record* for use where the expansion movement at the end seats and center pier of concrete bridges of the beam type precludes pouring the railing entirely monolithic with the rail posts and curbs.

Every third post is made an expansion point for both sets of entering rails, the intervening posts being poured integral with the rails.

The bottom rails in the two panels adjacent to each expansion post were kept separate from the bridge or wing wall by ¼-in. tarred felt joints. Tarred felt joints surrounding the sides and ends of the entering portion of the rail permitted freedom of movement in expansion posts and the reinforcing rods for rails were continuous through the remaining posts without joints.

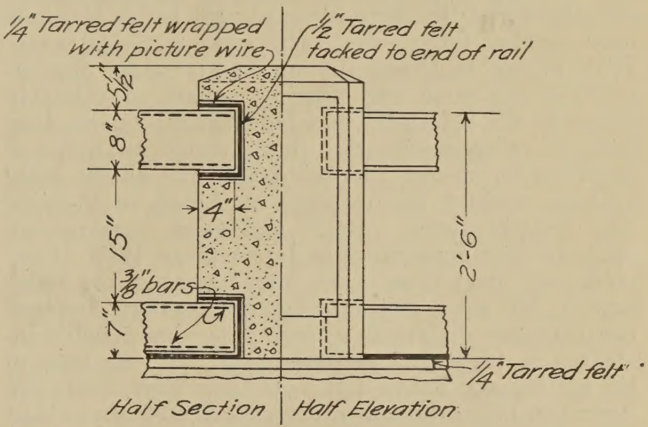

¼" Tarred felt wrapped with picture wire
½" Tarred felt tacked to end of rail
5½"
8"
4"
15"
⅜" bars
7"
2'-6"
¼" Tarred felt
Half Section
Half Elevation

Fig. 1—Details of Expansion Post

Forms for all posts and rails on one side of the roadway were built at one time. Concrete for the side was all poured at one time except in the expansion posts. After the concrete in the rails had set sufficiently, the form construction in the interior of the posts where expansion joints were provided was carefully removed from around the ends of the entering rails, tarred felt was applied, and the concrete for the posts poured. Deck movement and rail expansion were compensated by the expansion posts, the expansion joints being necessary only in every third post. This resulted in considerable saving in time and expense as compared to a design using an expansion joint in every post.

Mixer Chokes on Contractor's 1:2:5 Charge

One of the Koehring Co.'s customers complained about the inability of the Dandie mixer to hold a 1:2:5 mix. A representative was sent out to investigate. He reported that the contractor was very much "peeved" and that the machine was certainly slopping. On investigation, however, he discovered that the contractor's conception of a 1:2:5 mix was *one* bag of cement, *two* wheelbarrows of sand and *five* wheelbarrows of stone. The contractor was complaining because the mixer wasn't big enough to take an extra wheelbarrow or two occasionally when the inspector was not looking.
—*Engineering News-Record*

America Will Rebuild Japan

Col. W. A. Starrett, in an interview published in *The Forum Bulletin*, predicts modern buildings to be erected in Japan will be principally of American design and materials.

In viewing the recent disaster in Japan, the American manufacturer of building products finds his professional interest commanded by the sales opportunities in the program for rehabilitating the stricken area.

This is a natural attitude in view of the fact that all reports from the devastated districts include praise for the surprising manner in which American-built structures met the three-cornered attacks by Nature's most ruthless forces—fire, earthquake and tidal wave. With native buildings sinking in a collapse like so much match-wood and offering a path of veritable tinder to the holocaust that followed the quake, long lines of refugees streamed into American fireproof buildings for shelter. In this tragic and all the more striking manner the message of American building was brought home. Brick and stone construction made its first appearance in Japan about 1870. Concrete and steel came some time later, in the order named, but since this introduction, modern fireproof construction—American construction—has steadily increased in favor and general usage. At the time of the earthquake Tokyo and Yokohama were about 2% American-built; the four provinces affected were about 1%. In Yokohama, where the destruction was due almost entirely to the earthquake itself, it is estimated that 68,000 houses or 93% of the city was destroyed. This left very little except the American-built structures. Tokyo did not fare quite so badly. There, the fire rather than the earthquake wrought most of the ruin. Three hundred and sixteen thousand houses or 71% of the city was reduced to ashes, according to the most reliable reports available. The buildings left standing owed their escape either to American fireproof products or the protecting stroke of a destiny that turned the licking flames aside.

In the four provinces surrounding Tokyo more than 534,000 buildings were counted a total loss. The percentage figures that apply here were not available, nor the detailed part listing the triumph for American building, but at the office of the Consul General for Japan in New York an unofficial opinion was ventured that not a single American building suffered severe damage in the provinces. In Tokyo and Yokohama, the official report states that no American-built house was fatally damaged or destroyed.

With these figures before them, it is safe to anticipate a decided leaning to American construction and fireproof building products in the finding and recommendations of the committees on rehabilitation. The Metropolitan Reconstruction Board, with headquarters in Tokyo, has been invested with complete authority to rebuild Tokyo and Yokohama. This board, composed of more than six hundred and fifty staff members, was appointed in the latter part of September by the Premier.

Goto Favors Modern Construction

The fact that Viscount Goto has been put in charge is of great significance to American builders. It was Viscount Goto who, as Mayor of the "Eastern Capital" a few years ago, inaugurated the movement for a greater and more modern Tokyo. In this plan, modern building was to be pushed to the full extent of the means at hand. Mayor Goto's sound knowledge of practical building enabled him to adopt a policy that would sacrifice the picturesque features of the homeland architecture for the permanency and convenience embodied in the American models.

Hard Surface Roads Needed

Now that such an exceptional opportunity is offered to drive in the entering wedge of modern construction, Viscount Goto will unquestionably urge the construction of entirely new modern sewerage systems, at least in Tokyo and Yokohama. Water and gas mains and electric service conduits must be laid in anticipation of the growing need of such service, not only in the large number of modern buildings which will spring up within a few years as a part of the rebuilding program, but to take care of future demands. Streets in the larger cities must be paved. Hard surface roads, almost unknown in Japan, are badly needed, especially the highways connecting the wharves at the various ports with all centers where large new construction projects are to be carried on. This substructure work, such as sewers and various service lines, together with hard surface roads and adequate bridges which can stand up under heavy motor trucks must prepare the way for modernly equipped buildings.

Reconstruction Board at Work

As Chairman of the Reconstruction Board, Viscount Goto has divided it into seven bureaus, each handling a distinct department of the colossal task.. They are: (1) Finance, (2) Purchase and Supply, (3) Civil Adjustment, (4) Architecture, (5) Planning, (6) Civil Engineering, and (7) Secretary of the Chairman.

The exact amount of money to be turned over to the Metropolitan Board for the Reconstruction has not yet been determined. In fact, it is expected that the Government will not stipulate a sum until the Board has rendered an estimate founded on its investigations. However, Premier Yamamoto is quoted by the Home Minister as indicating that the figure will in all probability lie between five hundred million and one billion *yen* or $250,000,000 and $500,000,000. Probably half of this, still a very significant amount, will be put into modern, fireproof construction. This, coupled with the fact that American construction stood up through the three furious tests, seems to promise American products manufacturers a rather generous outlet when the Japanese announce themselves in the market. It is impossible here to consider the figure approximated by Premier Yamamoto, as an official appropriation will necessarily be but a part of all the money expended during the next five years. Possibly three or four times the amount of the official appropriation will be expended on substructure rebuilding and new building enterprises.

Japanese Production Inadequate

Japan has no quantity production of the fabricated products which will play such an important part in its rebuilding program. For the next five years there will be a great demand for finished hardware, window frames, radiators, valves, and countless mechanical appliances and specialties that have become a part of every modern building.

Japan has three portland cement plants whose total annual output is 5,000,000 barrels. This, however, will not be sufficient to take care of the immense reclamation work and new construction work which will start at once. The rolling mills now in operation in Japan have attained quantity production in cable, wire, and nails, but are not turning out heavier pieces in any quantity. Of course the logical source for specification steel, as well as all kinds of pipe, is the United States.

U. S. West Coast Lumber Needed

The native lumber of Japan is small, such as would be called "boxing" in our mills. No "dimension" lumber is turned out there. The west coast of the United States will supply lumber. Large trunks for piling must necessarily come from the United States. The only large trees in Japan are the giant Redwoods, which surround some of the temples. These trees are sacred, however, and cannot be considered as constituting a part of Japan's available lumber. Glass manufacturing as an industry has made little headway in Japan. The quality is poor and the present rate of production can supply only a small percentage of the present needs.

Just at present there is practically no effort being put into permanent building. Temporary barracks are being erected under the supervision of the Imperial Army and thousands of civilians are engaged both in this work and in clearing the cities of the farflung wreckage. Before this work is completed it is expected that both the Metropolitan Board and the committee in charge of restoring the Provinces will complete their investigations and publish recommendations and plans which they are now formulating to cope with the situation.

Not All Building Will Be Modern

Of course we must bear in mind the fact that there are hundreds of thousands of families who will rebuild their homes exactly like the ones that were destroyed. They will continue to live in these houses and will reach the ends of their lives, possibly, without ever knowing that there is such a land as the United States, much less knowing about American construction methods. A vast amount of rebuilding activities will be carried on independent of any rehabilitation building committee and practically all of this will be the old type of construction that has been used for many generations.

Opinion of Japanese Embassy

Mr. Shudo, Commercial Attaché to the Japanese Embassy, expressed belief that complete reports will be rendered at an early date. "It is highly probable," Mr. Shudo said in a recent interview, "that as soon as the recommendations are returned, orders will be placed, and buying on a gigantic scale will extend over a period of several years.

"We are highly satisfied," said Mr. Shudo, "with the endurance and resisting qualities of American building products. Their performance under the terrific scourge of the elements was a great testimonial of quality, a consideration that may have a strong influence on the recommendations of the Metropolitan Reconstruction Board. But because of the tremendous amount of money involved in the rehabilitation, it is my personal opinion that we may buy in the world market on a competitive basis. That, however, is not definite; it is one of the matters that will receive the attention of the investigating committee."

It is predicted in other official circles that the Board will urge as much fireproof construction as possible in the business districts, but for the suburbs and those residential sections where thrift plays an important part, native, and in instances where it is possible, semimodern construction will be recommended.

Some of the Building Necessities

Inasmuch as manufacturing in the United States has reached such heights in the way of quantity production and specialization, the specialty products made here will unquestionably be in demand for two very important reasons: the excellency of the product itself, and the attractive price made possible by quantity production. A few of the products which will be in demand are: door and window hardware, boilers and complete power and heating units, brick and clay products, building stone, pumps, elevators, all kinds of improved floors, such as cork, linoleum, rubber, tile, mastic, wood block and regular wood flooring, iron sidewalk gratings, furniture of all kinds (for the younger generation of Japanese, especially in the cities, are changing their habits and no longer live on the floor, but use furniture), sheet metal of all kinds, also specialties made of sheet metal, roofing materials for built-up flat roofs, expanded metal lath, electrical devices and appliances, telephone systems and instruments, lighting fixtures, time systems, ash hoists, glass of all classes, metal window frames and sash, both casement and double hung, incinerators, small capacity water heaters, slate, metal cabinets and dressers, drawn metal for store fronts, factory, laboratory and kitchen equipment of all kinds, gas and electric ranges, ventilating systems, fans, etc., insulation materials, floor safety treads, electrical conduit wire, all kinds of pipe, safety vaults, sprinkler systems, plumbing fixtures and appliances. But, above all, the cooperation and advice from architects and engineers who are competent to specify these specialty products is essential.

Japan Has Faith in American Products

Buying will be done on a scale that is far in excess of the volume hitherto experienced in the Japanese market by American manufacturers of building products. Already American building products are used in practically every modern building in Japan and these materials stood the recent test in a manner that was highly satisfactory to our customers. Japanese faith in American building products runs high. Our work in Japan has made a worthy record—one of which we may justly be proud and one which we are prepared to repeat. This is common knowledge in Japan; a fact which American builders and material manufacturers may regard with considerable assurance that the cordial relations will continue and that the reconstruction over the Pacific will be carried on in a manner of highest mutual satisfaction.

"Safety from Fire" is the title of a new publication issued by the Associated Metal Lath Manufacturers. It is a publication of 74 pages and cover, devoted to fire-protection engineering as applied to construction and occupancy of buildings, with recommended building ordinances for protection to life and conservation of property. It devotes itself to a considerable extent to the uses of metal lath, the weights and varieties to be used for various purposes.

The Fundamentals of Economical Garage Design

By Harold F. Blanchard
Automotive Sales Engineer, Ramp Buildings Corporation, New York

---

By Courtesy of the Author, The Portland Cement Association and *Building Management.*

Public garages are peculiar. In appearance they are much like factory buildings or warehouses but the resemblance is only superficial. In a factory or a warehouse the exact location of the columns and the position of the elevators or ramps do not appreciably influence the efficiency with which the space may be utilized; but, on the contrary, in the design of a public garage, the location of columns and means of inter-floor travel is everything. For example, in a large service building recently designed the original layout, which was O.K.'d by both architect and owner, accommodated 384 cars. By applying certain definite principles which should never be violated in laying out a garage it was possible to redesign this building so that it accommodated 573 cars, an increase of 189, or nearly 50%. The new design was just as ample and convenient in every respect and in many ways was more convenient than the first design.

It is the purpose of this article to describe these principles of layout so that any architect may apply them with success to any public garage which he is designing. The need for laying out the garage in full detail with every car in place is not thoroughly appreciated. The proper way to lay out a garage is to arrange the cars to give the most efficient storage and after this is done the columns should be located. The reverse procedure should never be used. Location of the columns to give maximum car storage may result in column spacing which is not quite ideal from the standpoint of building cost; but it is folly to save a few dollars on the first cost of a building by methods that will cut the income of the building perhaps 20%. In many cases buildings are designed without any regard as to how the cars should be arranged. The building designer assumes that this little detail will be solved by the garage operator. This is a serious mistake. The arrangement of cars is an integral part of the building design and is a duty that should not be overlooked by the architect. Of course, it is not to be expected that the architect can also be an expert garage man but he should obtain from the garage man an exact idea of how he wants the cars arranged. If the building is being erected by a promoter the architect will be looked upon as an expert and, therefore, will not receive aid from the owner. In such a case the architect should be particularly careful to obtain an efficient layout, for the success of the garage depends largely on how many cars it will accommodate.

In a great many cases the best way to lay out the building to obtain efficient car storage is to lay out the plot on a piece of tracing paper and then on another paper draw rows of cars and aisles (Figs. 1-A and 2-A); then place the tracing paper with the plot lines on it over this drawing, shifting the paper from one position to another until the best car arrangement is obtained. The most efficient arrangement is usually the most systematic. There is hardly an exception to this rule. Bizarre arrangements of one sort and another almost invariably must yield to a systematic arrangement. A little patience should readily determine the systematic arrangement which is best.

Consider that as a one-story building Fig. 1-A accommodates 59 cars while Fig. 2-A accommodates 63. If this building must be more than one story high some form of inter-floor travel must be included in the design. Fig. 2-A accommodates more cars because the size of the plot is such that it is possible to place a double row on one side of an aisle. Objections may be offered to this arrangement but the objection is more theoretical than practical. Some of the best garages in the country, including several in New York city catering to the best trade, use this arrangement. When it is employed the cars in the back row should be the ones going out late and those in the row immediately in front should be cars which are going out early. Cars whose going is doubtful should be placed in some of the other rows. This work may well be left to the floorman in the garage and in actual practice no confusion results. This double row arrangement should be employed wherever the plot dimensions make it necessary and if garage rentals are very low it may be desirable to design the building especially to employ this double row arrangement. For convenience, let us call this arrangement the three-row single aisle arrangement and, similarly, let us refer to the standard arrangement with two rows of cars facing a central aisle as the two-row single aisle arrangement. Incidentally, combinations of these two arrangements will provide for the efficient design of almost any size or shape of building.

The plan shown in Fig. 1-B is equipped with an ordinary ramp and 43 cars are accommodated. It should be noted that if the building is several stories high this ramp occupies the same position on each floor. In other words, the floor patterns of all floors are identical. Usually this is a more economical and satisfactory method of locating the ramps than to have the ramp in a different position on each floor. Obviously, there is only one best car arrangement and this arrangement cannot be realized if the ramp occupies a different position on every floor.

Fig. 1-C indicates the arrangement of cars if a single elevator is employed. It so happens that in this particular case the elevator may be fitted in without removing any cars either for the elevator itself or for an approach to the elevator. For this reason 55 cars may be stored.

Fig. 1-D illustrates the d'Humy Motoramp System. The building is divided into two sections, the floors in one section coming half way between the floors in the other section. This ramp system occupies the space of only 8 cars. In other words, 51 cars per floor may be accommodated as against 56 in a one-story building on this plot.

Fig. 2-B illustrates another ramp arrangement which, by coincidence, permits the housing of exactly the same number of cars as the first common ramp design, Fig. 1-B. Fig. 2-C illustrates a layout with one elevator. The street has been assumed to be on the opposite side of the building from the location shown in Fig. 1-C and as a consequence the car storage is reduced to 53. An elevator, therefore, is not necessarily more economical of space than a ramp system as is

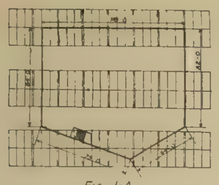


Fig. 1-A
59 Cars

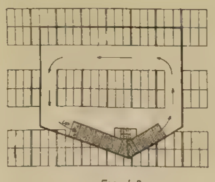


Fig. 1-B
43 Cars

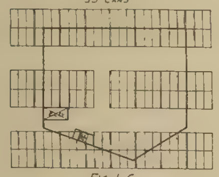


Fig. 1-C
55 Cars

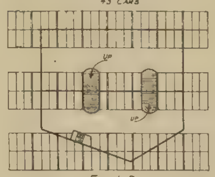


Fig. 1-D
51 Cars

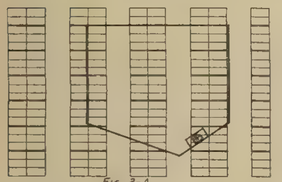


Fig. 2-A
63 Cars

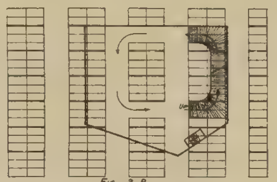


Fig. 2-B
40 Cars

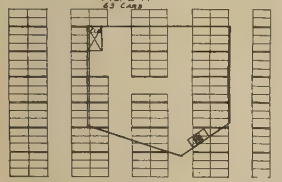


Fig. 2-C
53 Cars

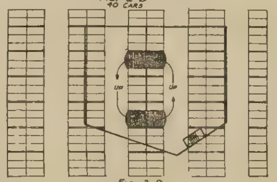


Fig. 2-D
55 Cars

proved by the fact that Fig. 2-D, with the d'Humy Motoramp System, accommodates 55 cars. This layout is by no means exceptional and may be duplicated in a great many cases.

In making these layouts it has been assumed that a car requires a space 6½ ft. x 15 ft. net. This figure was obtained by measuring up the spaces actually used in a great many garages. It is the most popular set of dimensions and the width of aisle is considered to be practically 20 ft. This also is the popular width. In most garages three-car bays work out to best advantage and, usually, the columns are about 1½ ft. in diameter. In other words, the width of column per car is 6 in. If four-car bays are used it is likely that columns will be 2 ft. in diameter so that the rule still holds with fair exactness. As pointed out at the beginning, it is not desirable to locate the columns until the correct car arrangement is obtained. At the same time, some provision must be made for them in preliminary layouts and a great deal of experience has proved that the best method is to add 6 in. to the frontage of each car in making the preliminary layout. In other words, instead of considering the necessary frontage per car as 6½ ft. think of it as 7 ft. and thus the amount of space which must later be allotted to columns is automatically taken care of. For example, if you wish to lay out a garage 50 ft. x 100 ft. it is obvious that it would consist of two rows of cars with a central aisle and that there would be a row of columns along each side of the aisle. The depth of the car space would be 14 ft. or 15 ft. and the width of the aisle 19 ft. or 20 ft. The distance of the columns from the side walls would probably be about 14 ft. Considering the car frontage as 7 ft. and the length of the garage, less end walls, as 98 ft. the number of cars which may be accommodated in each row is 14. A row would, therefore, consist of two four-car bays and two three-car bays or, perhaps, four three-car bays and one two-car bay.

Let us next assume that we have to lay out a garage 120 ft. x 152 ft. As previously, the plot is laid out on a piece of tracing paper and various arrangements are tried. It will be found that the two most feasible arrangements are exemplified by Fig. 3-A-E and Fig. 4-A-E. Fig. 3 shows the cars arranged in six crosswise rows facing on three aisles, whereas Fig. 4 shows the cars arranged in five lengthwise rows facing on two aisles. It is not necessary to count the cars in order to know that Fig. 4 is fundamentally more economically arranged than Fig. 3 *because the aisle space is less.* Fig. 3-A accommodates 78 cars. It is equipped with an ordinary ramp 20 ft. wide. The ramp occupies the space of 12 cars. A ramp of this width is frequently called a double ramp but this is an error which really is very serious and has resulted in wastage of a great deal of good garage space in many buildings which are now in use. Since the net width of a single ramp should be 8 ft. or 9 ft. it is plain that this 20-ft. ramp is wide enough for cars to pass upon it, and therefore, it does merit consideration as a double ramp; but cars cannot pass at the junction between the ramp ends and the aisles. Inasmuch as cars cannot pass at these points it must be a single ramp at these points regardless of its width and, inasmuch as it is a single ramp at its extremities, it is wasteful of space to make it more than a single ramp at any other point. On the other hand, if a double ramp is an actual and not a theoretical requirement for the garage under consideration, the ramp should be made wide enough or redesigned so that it is actually a double ramp at all points. A considerable number of garages having a capacity of 200 to 400 cars have been designed with ramps 20 ft. wide. The ramps were considered as double ramps but in actual use have proved to be single ramps. Fortunately, in most of these cases need for a double ramp was overestimated. What the building really required was a single ramp. Therefore, the ramp has not failed to prove adequate; but, on the other hand, the 20-ft. ramp is occupying much more space than is required for a single ramp. In this building, by reducing the ramp to a width of 13 ft. four more cars may be stored and if the building is six stories high the total becomes 24 cars. The income on 24 cars at $15.00 a month is $4300 a year. This is most eloquent testimony as to the importance of this little point.

If the building is large enough to require a double ramp it is better to divide the up and down ramps as shown in Fig. 3-B; thus completely separating the traffic on the ramps. This arrangement accommodates 74 cars. To be consistent the car passage should have a width equal to that of the two ramps. In other words, it should be four cars wide instead of three; but actually the three car passage will usually be sufficient even though it is necessary to have separate ramps for up and down traffic. Cars have absolutely separate paths except at the turns where this passage connects with the aisles and inasmuch as the "visibility" between the connecting passage and the aisles is much better than between the aisles and the ramps, since the ramps are boxed in, no trouble should be experienced between cars going in opposite directions. Fig. 3-C shows the building equipped with the d'Humy Motoramp System, the paths for up cars and down cars being absolutely separated at every point, not even contacting on the aisles. Eighty-two cars are accommodated.

Fig. 3-D illustrates an elevator installation, assuming that the street is at the end of the lot. It is assumed that the building is five stories high and that it accommodates approximately 400 cars or 300 cars above the first story. It is usual in garage practice to use one elevator for every 100 to 125 cars, provided the building is not too tall. With the Automobile Club of America, for example, where the garage extends from the fourth to the eleventh floor, this rule was followed with disastrous results. There are 600 cars in the building and six elevators and it is sometimes necessary to wait from 15 minutes to half an hour during rush hour periods for elevator service. However, in the ordinary garage building not over six stories high an elevator for each 100 to 125 cars stored is ample. On this basis four elevators are required in the building under consideration and these four elevators take up the space occupied by seven cars but the approach to the elevators also occupies a space of seven cars, and connecting passages reaching to the other aisles take up six more spaces, making the net storage 82 cars per floor. In Fig. 3-E it is assumed that the

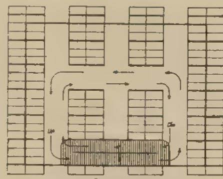


Fig. 3-A
78 Cars

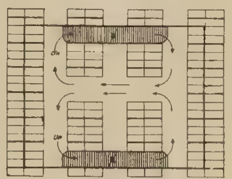


Fig. 3-B
74 Cars

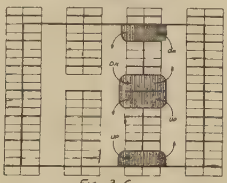


Fig. 3-C
82 Cars

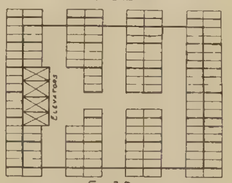


Fig. 3-D
82 Cars

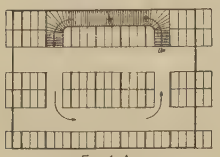


Fig. 4-A
83 Cars

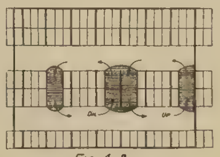


Fig. 4-B
94 Cars

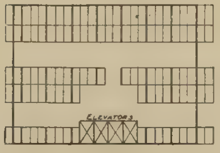


Fig. 4-C
94 Cars

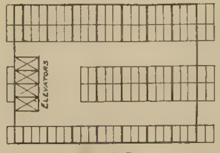


Fig. 4-D
94 Cars

street is on the long side of the building but the number of cars accommodated remains 76 per floor.

Fig. 4-A illustrates the building with the cars arranged longitudinally. A single ramp of ordinary design is shown. Eighty-three cars are accommodated. If the building is equipped with a single d'Humy Motoramp, 102 cars may be housed while if the building has a double d'Humy Motoramp (Fig. 4-B), there will be spaces for 94 cars per floor. Fig. 4-C shows one elevator arrangement which accommodates 94 cars and Fig. 4-D another elevator arrangement which also stores 94 cars.

Turning now to a plot 100 ft. x 140 ft., there are three arrangements which merit consideration. Fig. 5-A, of course, is the best because the amount of space devoted to aisles and connecting passages in this design is the minimum. As a one-story building this arrangement will accommodate 80 cars. Elevators or d'Humy Motoramps may be used in this layout without altering it but it is impossible to fit an ordinary ramp into it without seriously upsetting the systematic arrangement shown. If ordinary ramps are used Fig. 5-B would be preferable. D'Humy Motoramps or elevators, of course, may be used in all three layouts. Fig. 5-B accommodates 84 cars if it is a one-story building and Fig. 5-C, 80 cars if it happens to be a one-story building on a corner so that direct entrance may be obtained to all aisles. There are some cases where a longitudinal arrangement of the cars, as shown in Fig. 5-A, will not prove feasible. It is, therefore, necessary to use a crosswise arrangement. The major portion of Fig. 5-C employs the crosswise arrangement while the remainder of the space has the lengthwise arrangement. Fig. 5-B uses the crosswise arrangement exclusively. Two of the garage sections are 50 ft. x 100 ft. and the third section is 40 ft. x 100 ft., which means that full-sized cars 15 ft. long, on the average, may be stored in four of the rows, but that only small cars may be accommodated in the 40-ft. section. This arrangement is perfectly feasible provided Fords and other cars of this size are stored in the 40-ft. section. The 40-ft. section is ample for Fords. If this section happened to be 45 ft. instead of 40 ft. it would be large enough for medium-sized cars. In laying out a plot of this size, if it is necessary to have all car space a full 15 ft. deep and yet necessary to have some crosswise rows, then the arrangement shown in Fig. 5-C must be employed. Regardless of the form of inter-floor travel used, Fig. 5-C must have two cars removed at *A* and *B* in order to provide access to the short aisles.

Circular ramps or spiral ramps are occasionally used in garages. The objection to them, however, is that they take up too much space. The whole scheme of a garage is on the square. The cars are rectangular, the rows of cars are rectangular and so are the aisles. When the circular ramp is introduced into such a scheme there is always a great deal of lost space. The straight ramp designs which are shown will invariably prove more economical and just as satisfactory as any circular ramp.

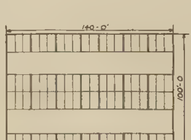


Fig 5-A
80 Cars

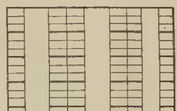


Fig. 5-B
84 Cars

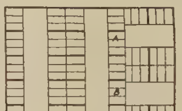


Fig. 5-C
80 Cars

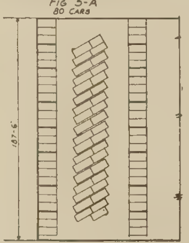


Fig. 11
90 Cars

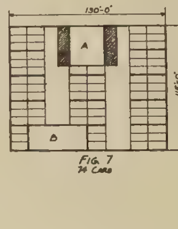


Fig. 7
74 Cars

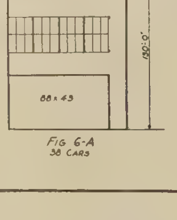


Fig 6-A
38 Cars

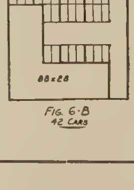


Fig. 6-B
42 Cars

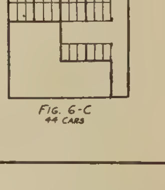


Fig. 6-C
44 Cars

In designing a garage it must be considered that a car occupies not only its own space, usually 6½ ft. x 15 ft., but also that it occupies half of the aisle upon which it fronts. Therefore, it is necessary to have a row of cars *on each side of the aisle* if there is any possible way of doing so. If there is a row of cars on one side of the aisle only it means that each car is occupying twice as much aisle space as it should. Such a condition will reduce the efficiency of the layout. For example, Fig. 6-A shows a one-story building 100 ft. x 130 ft. At the front is a showroom, accessory store, and office, etc., 88 ft. x 43 ft., leaving a garage space 87 ft. x 100 ft. In this space there are 38 cars, or one car for every 232 sq. ft. Considering that no space is devoted to inter-floor travel this figure is too high. Obviously, more cars can be stored by reducing the area of the aisles in this layout and in Fig. 6-B it is seen that by rearranging the store and office space, 42 cars may be stored. In many cases this space for stores and offices will be just as desirable as the former. Four more cars are accommodated by this simple change. Storage in the garage may be increased to 44 cars by the arrangement shown in Fig. 6-C, this gain being obtained by locating six cars without direct frontage on the aisle.

Fig 7 shows two room locations of approximately the same area. Room *A* takes up the space of 10 cars whereas room *B* occupies the space of 6 cars. The shaded portion along side room *A* indicates the amount of aisle space which is really occupied by room *A*; although it is impossible to award this space to room *A* because if this is done cars at *C* would not be able to get in and out.

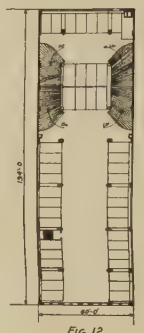


Fig 12

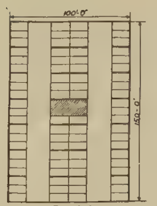


Fig 8-A
80 Cars

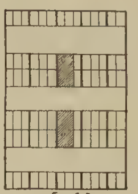


Fig 8-B
76 Cars

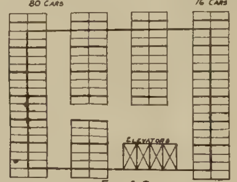


Fig. 3-E
82 Cars

Fig. 8-A shows a building 100 ft. x 150 ft. in which 84 cars are accommodated if the building is one story high. Eighty-four cars are also accommodated in this building if crosswise rows are used, as in Fig. 8-B. However, if the building is more than one story high connecting passages will be required between the main aisles. Inasmuch as Fig. 8-A has only two aisles, but one connecting passageway will be required. The installation of the passageway will reduce the capacity to 4 cars, as indicated by the shaded lines, whereas Fig. 8-B has three aisles and two passage-ways each causing a loss of 4 cars. Fig. 8-B, therefore, will accommodate 76 cars instead of 80, as in Fig. 8-A. In other words, regardless of the inter-floor travel employed in any building more than one story high on a plot of this size, Fig. 8-A will always accommodate 4 more cars than Fig. 8-B.

This plan very aptly illustrates an important principle. Efficiency of garage design consists in keeping the aisles and passageways down to a minimum area. It is plain that the average car occupies a space of approximately 6½ ft. x 15 ft. and that this figure cannot be varied to any extent; also aisles must be 20 ft. wide. Therefore, if one plan is more efficient than another plan it must be obtained by minimizing the area devoted to connecting passages, and in addition, aisles must be utilized to the fullest extent. In other words, cars must be parked on both sides of the aisle wherever possible.

The location of a stairway or an elevator or both in a garage usually results in the loss of two or three cars per floor. Sometimes this cannot be avoided, but in most instances a little ingenuity will show some method whereby the presence of these features will not reduce the car capacity.

Fig. 9-A shows a stairway location which occupies the space of only one car. Ordinarily, this stairway would occupy two spaces. But if one corner of the stair wall includes the column it is not usually necessary to lose more than one car. The average stairway is about 8 ft. wide. The width of the average column is usually 1½ ft. and the width of the car space 6½ ft., making 8 ft., which is just what is necessary. Fig. 9-B shows a stairway and passenger elevator location placed between two rows of cars. Shorter cars are located in front of the stairway and the elevator to compensate for the space actually occupied by these features. There is usually enough space between the cars to permit reaching the elevator or stairway. However, where a separate pathway is desired it is not usually necessary to devote a whole car space for this purpose.

In almost every instance it will be possible to add a foot or two to the frontage of this particular bay without changing the number of cars accommodated on the floor. For example, suppose that a preliminary calculation shows that each row in the garage will house 12⅓ cars. The fraction is of no service. It is impossible to squeeze 13 cars in a row. On the other hand, the space represented by this ⅓ of a car is more than ample for a walk, as shown in the figure.

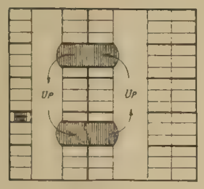


FIG. 9-A

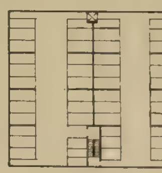
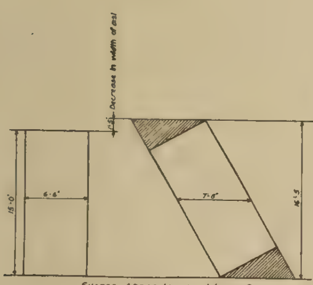


FIG.-9-B



SHADED AREAS INDICATE WASTE SPACE
FIG. 10

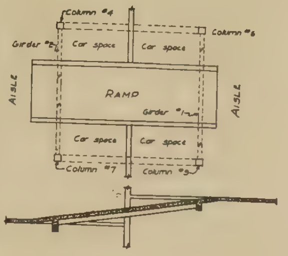


FIG 14

In case the stairway comes on a line where the floors are staggered, the walk will connect alternate landings, as illustrated. Stairways and passenger elevators similarly located may be reached directly from the connecting passage aisle connecting main aisles.

Parking cars at an angle is frequently urged as a system superior to the ordinary method, but a careful analysis of the situation very quickly shows that this idea is not sound. Any one with a knowledge of trigonometry, or even of geometry, should be able to realize at a glance that nothing is to be gained by diagonal parking. Any one can be convinced of the truth of this statement by studying the simple diagram in Fig. 10. The advantages urged in favor of this scheme are that it is easier to park a car and easier to drive it out of its parking space. It is true that the car may be driven out more readily, provided that it is pointed down the aisle in the direction in which it is to go. Otherwise some provision must be made for turning the car around when it is out of its space. If the car is placed at an angle, as shown in Fig. 10, its frontage instead of being 6½ ft. becomes more than 7 ft. measured parallel to the aisle and its length instead of being 15 ft. becomes nearly 16½ ft. thus reducing the width of the aisle 1½ ft. on either side or 3 ft. total. The aisle, therefore, becomes 17 ft. wide instead of 20 ft. and this narrowed dimension largely offsets any advantage in the diagonal arrangement. In the design shown in Fig. 11 it is clearly indicated that a row of 19 cars parked diagonally is accommodated in a length which will accommodate 22 cars parked at right angles to the aisle.

It is not usually feasible to locate an ordinary ramp in a long narrow building, especially if the building is more than two stories high. In such a case the d'Humy Motoramp System works out to very good advantage, as shown in Fig. 12.

The following facts will be of service in designing various garages:

A single ramp is usually sufficient for 300 cars, whereas a double ramp should be used for any garage in excess of 300 cars. The number of cars a properly designed double ramp will accommodate is almost unlimited, and in this connection it is worth while pointing out that two 10-story garages, one for the downtown section of Chicago and the other for Los Angeles, are now being contemplated. It is expected that eventually the Chicago building will be increased to 20 stories.

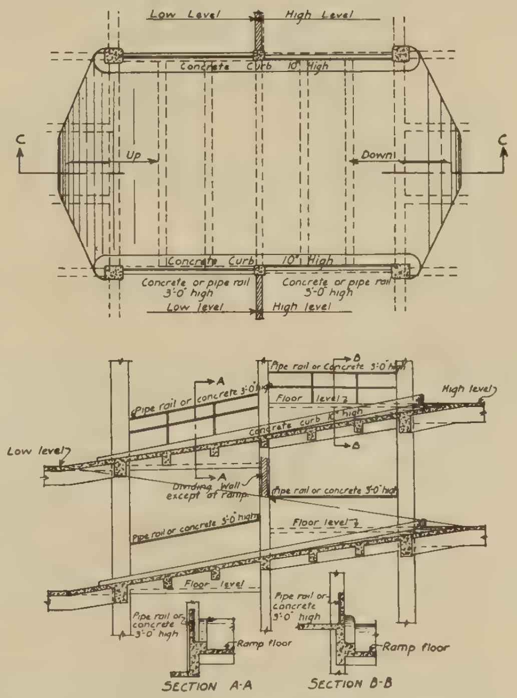
An elevator will handle from 100 to 125 cars provided the building is not too high.

The modern tendency is to prefer the ramp to the elevator. This statement goes without exception for the larger buildings and is becoming increasingly true of the smaller buildings as the problems affecting the ramp are becoming better understood.

Circular ramps and even straight ramps with curved ends are frequently considered in a building design, but usually it is found that it is better to use a perfectly straight ramp, making it 2 cars to 2½ cars wide, as required. A ramp which is two cars wide, or 13 ft., opening onto a 20-ft. aisle, will handle practically all cars. It should be noted here that in speaking of a ramp as being 2 cars wide it is not meant that it will accommodate 2 cars but that it takes up a space the width of 2 cars. In other words, a single ramp should be 12 ft. to 15 ft. wide. The curb at either side of the ramp should be about 9 in. high and 9 in. wide. The slope of the ramp should be approximately 15%; although occasionally it is desirable to use a ramp with a 20% grade. There is no objection to a 20% ramp from any car operating standpoint, but some motorists are timid about using a grade of this character. The 15% grade, however, is perfectly satisfactory and all motorists will like it. It is not desirable to make the grade less than 15%, first, because nothing is gained thereby and, second, because if it is made less, something is lost because the more gradual the grade the more space occupied by the ramp.

It is not necessary to surface the ramp with any special material. Ordinary concrete is sufficient. Nor is it necessary to cut cross grooves to prevent skidding. The concrete itself offers sufficient friction to hold the wheels at all times.

In laying out ramps and connecting passages it is a good plan, wherever possible, to consider that the maximum turning circle of all automobiles is 70 ft., but where this consideration interferes to any extent with the design, it is desirable to reduce the turning circle to 60 ft., inasmuch as there are only a few cars in operation in the country with a turning circle in excess of 60 ft. and it is not good economics to go to any particular expense to accommodate the cars in excess of this figure. Many garages will not have a car with a circle in excess of 60 ft. within its walls once a year and this occasional customer may be accommodated on the first floor; and even in a city like New York, where there are a great many large cars, a 60-ft. turning circle is feasible. The cars in excess of this figure are placed on the first floor. A truck garage should be allowed a turning circle of 95 ft. if all trucks are to be accommodated, and the ramps should be about 20 ft. wide. However, here it is again best to consider that the large trucks will be placed on the first floor and, therefore, a turning circle of 70 ft. is usually sufficient. A singe-track ramp is sufficient for nearly all truck garages, since all traffic is *out* in the morning and *in* at night.


Low Level
High Level
Concrete Curb 10" High
C
Up
Down
C
Concrete Curb 10" High
Concrete or pipe rail 3'-0" high
Concrete or pipe rail 3'-0" high
Low level
High level
B
Pipe rail or Concrete 3'-0" high
A
Pipe rail or concrete 3'-0" high
Floor level
High level
Concrete curb 10" high
B
Low level
A
Dividing Wall except at ramp.
Pipe rail or concrete 3'-0" high
Pipe rail or concrete 3'-0" high
Floor level
Floor level
Pipe rail or concrete 3'-0" high
Pipe rail or concrete 3'-0" high
Ramp floor
Ramp floor
SECTION A-A
SECTION B-B

SECTION C-C
FIG 13

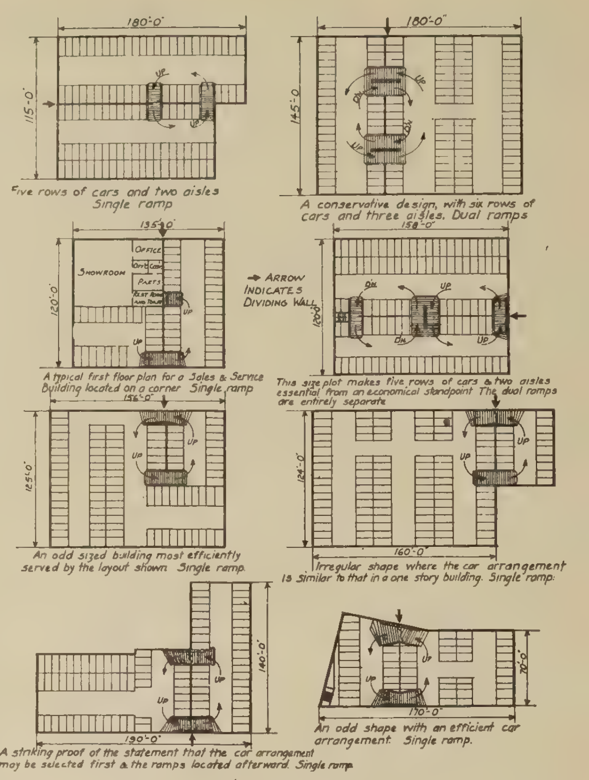
A great many garages have been built with the floors too far apart, thus wasting much money. In the average garage it is sufficient to make the distance between the floors 10½ ft. or 11 ft. There are no cars in use today higher than 7½ ft. Therefore, a net headroom of 8 ft. is ample for passenger cars.

If trucks are to be used it is a good plan to vary the headroom. A few of the very largest trucks will require a headroom of close to 12 ft. whereas delivery cars and small trucks may not require a headroom of more than 7 ft. or 8 ft. Therefore, the first floor may be made with a headroom of 12 ft. and the other stories with a headroom of 8 ft.

Trucks vary greatly in size and in designing a truck garage it is desirable to know something about the character of the trucks to be stored before the building is designed. Delivery wagons and various small trucks have the same dimensions as passenger cars and fit nicely into a 6½ ft. x 15 ft. space. On the other hand, the very largest trucks require a space 8 ft. x 22 ft. There are few trucks longer than 22 ft. The average truck may be considered to fit in a space 7½ ft. x 18 ft.

In designing a garage for both trucks and passenger cars it is desirable to use four-car bays, since a four-car bay will accommodate 3 large trucks economically; thus the whole garage may be used interchangeably for the storage of trucks or passenger cars.

While the average passenger car occupies a space 6½ ft. x 15 ft. it is worth while mentioning that Fords are only 11 ft. long, while a few of the largest cars such as the Locomobile or Pierce Arrow are 18 ft. The Cadillac is about 16 ft., the Dodge 13 ft., etc. In some



Five rows of cars and two aisles
Single ramp

A conservative design, with six rows of cars and three aisles. Dual ramps

A typical first floor plan for a Sales & Service Building located on a corner Single ramp

This size plot makes five rows of cars & two aisles essential from an economical standpoint The dual ramps are entirely separate

An odd sized building most efficiently served by the layout shown Single ramp.

Irregular shape where the car arrangement is similar to that in a one story building. Single ramp.

A striking proof of the statement that the car arrangement may be selected first & the ramps located afterward. Single ramp

An odd shape with an efficient car arrangement. Single ramp.

Fig. 15—Typical Plans Showing Possible Arrangements of Ramps

cases in designing a garage it is desirable to keep in mind the fact that where some long cars are to be accommodated it is possible to place short cars on the other side of the aisle.

Fig. 13 shows the ideal ramp design. In designing a ramp it is highly desirable to bring the ramp out into the aisle for 2 ft. or 3 ft. in order to reduce its grade. Furthermore, the line marking the intersection of the ramp surface with the floor should be approximately at right angles to the car path. It is not necessary for this line to be exactly at right angles but it should be approximately so. Ten or 15° makes little difference but 50° makes a lot of difference. Unless the path of the car is approximately at right angles to this addition the ramp should be so designed that its surface melts gradually into the floor surface so that there will be no sharp bump when the car enters or leaves the ramp.

It has been generally realized that all these features are desirable, but a simple method of obtaining them is not always found. Therefore, we should like to recommend the design indicated on Fig. 13. A plan view and a sectional view are shown. While the ramp illustrated is the d'Humy Motoramp, the details of the ramp construction may be used just as effectively in designing any ramp. The slope of the ramp is extended out into the car aisle in a very simple manner, as will be seen by studying the section, which shows that the floor itself is warped by meeting the ramp and that this end is attained by raising the main cross beam in one case and lowering the main cross beam in the other.

This is the design that was used in a garage at Poughkeepsie and has proved to be absolutely satisfactory in every way and Edward C. Smith, the architect, should receive full credit for working out the details.

No dimensions are given on the illustration herewith but in most cases it is recommended that the ramp occupy a breadth of two cars and that its length be the length of two cars plus an encroachment of 3 ft. into each aisle, making the total length of the ramp nearly 40 ft. and its width about 13 ft. These dimensions will give a ramp whose proportions vary somewhat from the drawing herewith because the ramp in the Poughkeepsie building occupies six car spaces instead of four car spaces, its extra width being due to the fact that the designers of this garage thought that it might be used for trucks at some time.

In designing a ramp it has usually been considered necessary to have a column at each corner of it, as illustrated in Fig. 13. It is not necessary, however, to follow this construction unless it happens to be the most desirable, of course. In a great many cases, to locate columns at the corners of the ramp will interfere with the ideal column arrangement for the whole building. For example, if the width of the ramp is two cars and, therefore, occupies a width of two cars in a three-car bay, it is desirable to maintain the three-car bay column arrangement regardless of the presence of the ramp; or if the ramp occupies the two central car spaces in a four-car bay, and sometimes this is the most desirable location, to locate a column at the ramp corners in addition to the bay columns may cut down the car space on either side so as to render these spaces useless or, at least, awkward. All these difficulties may readily be avoided by using a modification of the design shown in Fig. 13. It will be noted that the ramp is supported by girders Nos. 1 and 2, which run, respectively, between columns 6 and 9 and columns 4 and 7. Suppose, however, that the ramp, instead of being three cars broad, is two cars broad, and that it is located in the center of a four-car bay, there being a car space at either side of it. The layout is illustrated in Fig. 14. Girder No. 1 is constructed exactly as shown in Fig. 13 except that where it supports the floor on either side of the ramp it is filled in up to the floor. Girder No. 2, on the other hand, is made enough deeper in section so that its depth is normal where it supports the floor at either side of the ramp. In effect this means that girders Nos. 1 and 2 are filled in at the points *F*, Fig. 14.

Ramps are just as suitable for service stations as they are for garages. In this connection it is worth while pointing out that a ramp is more convenient in handling a disabled car than the elevator. Without exception, when a disabled car is brought into a garage it is at the rear of a tow car and the tow car is fully capable of hauling it up the ramps. On the other hand, if the building has elevators instead of ramps the car must be disconnnected, pushed onto the elevator, carried to its destination floor and pushed off again. This is not a difficult procedure if the car has all four wheels in good working order but, frequently, when a car is brought in, one end of it is badly smashed, this end being hung from the rear end of the tow car. Under these circumstances the tow car can pull the disabled car up the ramps just as well as it can along the level. On the other hand, if the building is equipped with an elevator it will be necessary to disconnect the wreck from the tow car, using skids or rollers to place the car on the elevator and then the same laborious job must be repeated when the car is taken off. There is not only the work of getting the car on and off that has to be considered but also the fact that the elevator is being held up and cannot be used for other work during this time.

Large Volume of Supplies Needed by Big Industries

How many large manufacturing enterprises create huge volumes of business for other concerns is shown by figures recently compiled covering the demands of the cement industry. According to the report of the United States Geological Survey, 117,701,216 barrels of portland cement were shipped in this country last year. In producing this material the cement mills used enormous quantities of supplies, furnished by various other industries.

For example, well over 46,000 miles of wire were used in making wire ties for the cement sacks shipped during the year. Approximately 8,500,000 tons of coal were burned at the cement plants, and in addition 3,400,000,000 cu. ft. of gas and 4,400,000 bbls. of fuel oil were consumed. Over 15,000,000 lbs. of dynamite and explosives were shot off in cement quarries in blasting loose the year's supply of raw materials. Over 300 miles of belt conveyors were worn out and had to be replaced during the year. The heavy machinery in the various mills required 32,600,000 lbs. of oils and greases for lubrication purposes, and over 4,500,000 fire brick were used in relining the huge kilns in which the raw materials are burned.

Although an individual cloth cement sack is a small thing in itself, approximately 50,000,000 sacks were worn out, destroyed or failed to come back to the mills last year and it was necessary for textile mills to use over 50,000 bales of cotton in weaving the cloth needed for replacements. Only a small percentage of portland cement is shipped in paper sacks, yet 7,000,000 lbs. of paper were used in making such sacks in 1922.

In addition to these supplies the industry bought quantities of heavy grinding and burning machinery, locomotives, cars, rails and other equipment needed in producing the year's supply of cement.

Big Sewer Jobs Economical in Concrete

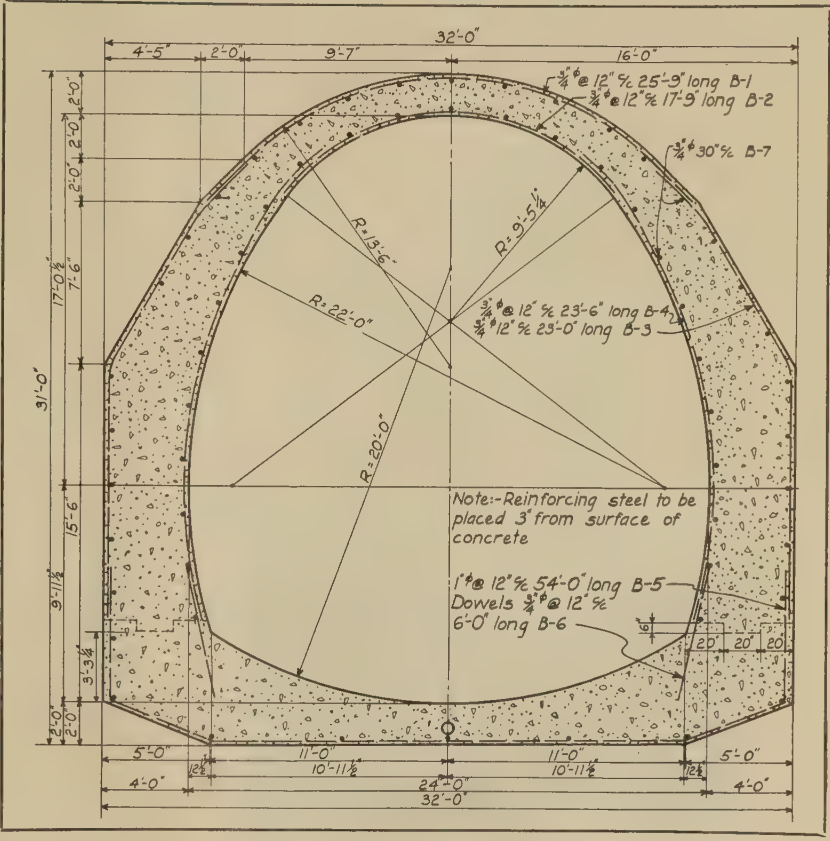
Concrete sewers have been constructed in cities of America for over 80 years. In the early days the diameters of these sewers rarely exceeded 4 or 5 ft., but with the growth of cities, necessitating the drainage of large areas, much greater capacities are required. Concrete sewers are today being constructed with internal diameters exceeding 25 ft. The two largest sewers on record are the Connors Creek sewer, built in Detroit in 1922, and the extension of the Thirty-ninth street conduit in Chicago.

The former drains an area of 41 sq. mi. and a section 7700 ft. long was built in 1923 at a cost to the city of $2,190,850.00, or $284.53 per lin. ft.. Fig. 1 gives an excellent construction view of this sewer. Its external dimensions are 55 ft. 1 in. x 22 ft. 6 in., and it is divided into three 17 ft. 6 in. x 15 ft. 9 in. conduits.

The Thirty-ninth street conduit, now under construction in Chicago, has internal dimensions of 27 x 24 ft. and is of the horseshoe type section. Contract for this sewer was awarded in 1922, at the rate of $492.00 per lin. ft., or approximately $2,600,000.00 per mi. It will be noted that the haunches of the sewer are 5 ft. thick, with the crown and invert each 2 ft. thick.

The city of St. Louis, Mo., has plans under preparation for a 32-ft. horseshoe type of sewer, as well as twin 29-ft. sections. This city has already constructed a number of concrete sewers up to 23 ft. internal dimensions.

There is hardly a large city in America that has not built concrete sewers in diameters exceeding 4 ft. The outstanding advantages are permanence, great strength, greater carrying capacity as compared to competitive materials, and economy. In fact, it is doubtful if the large sewers mentioned above could be built of any other material than reinforced concrete. If brick were used, the probabilities are that it would cost from 25 to 35% more than for reinforced concrete.



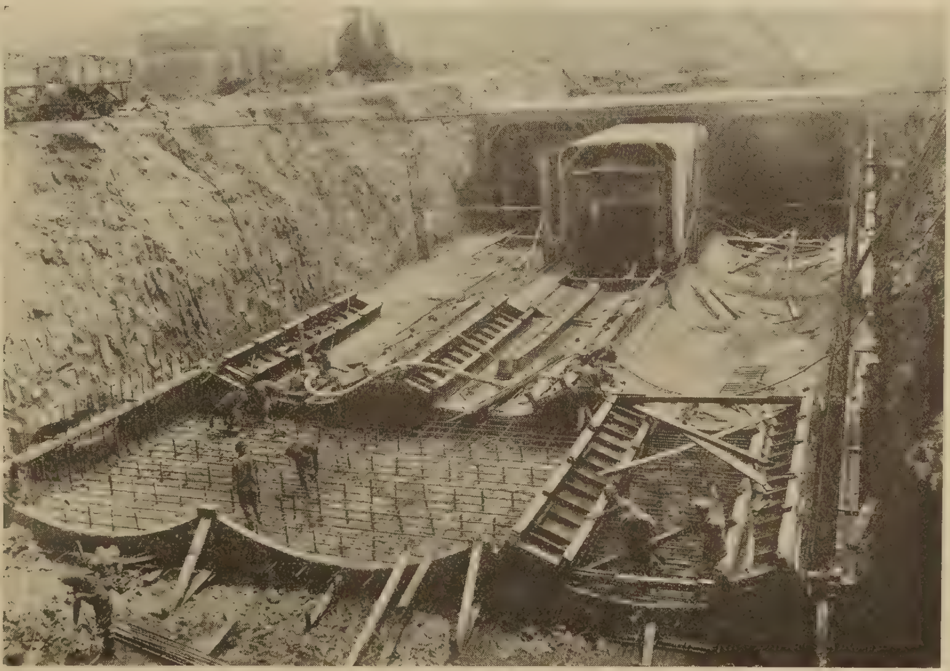


Fig. 1—Construction of Connors Creek Sewer, Detroit, Built 1922

Fig. 2, Above—A Section of 39th Street Sewer, Chicago. Internal Dimensions, 24 x 27 Ft.

From the records of the Sanitary District of Chicago, over a period of eight or ten years, bids on monolithic concrete have been from 15 to 20% lower than those for brick construction in diameters ranging from 6 to 17 ft.

While monolithic concrete sewers or those built in place have been constructed in internal diameters as low as 2 ft., reinforced concrete pipe are now commonly used for sewers in the diameters from 27 to 72 in. Cities that formerly used monolithic concrete for this range of sizes are gradually specifying the use of reinforced pipe.

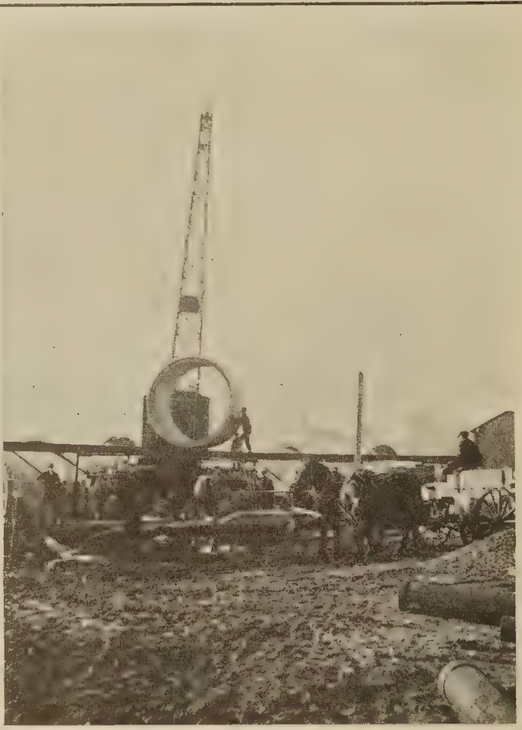
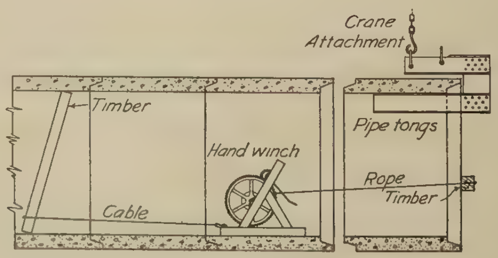


Fig. 3—Placing 108-in. Concrete Sewer Pipe, Hammond, Ind.

In the past, the use of large pipe was limited because of the light equipment used by sewer contractors. Recently, however, contractors are fitting themselves with heavy equipment, and the past two years have witnessed the use of very large reinforced pipe, particularly in the diameters from 72 to 96 in. In one case, 108-in. pipe has been placed. Fig. 3 shows 108-in. pipe being placed at Hammond, Ind., and Fig. 4 illustrates methods used in drawing these units together after they have been lowered into the trench with a large crane.

The characteristic features of reinforced concrete pipe which make its use especially profitable are its great strength, great carrying capacity and permanence; certain advantages also accrue from plant manufacture with its possibilities for accurate quality control. Table 1 gives the table of carrying capacity of concrete pipe over competitive materials. While many engineers do not give the manufacturer of reinforced concrete pipe this advantage, there is no reason, from an engineering standpoint, why a smaller diameter of concrete pipe should not be substituted for a larger diameter of brick or segment block sewer.



Method Used in Joining Pipe Sections at Hammond, Ind.

Table I

Comparative Discharge of Sewers Built with Reinforced Concrete Pipe, Clay Segmental Block or Clay Brick

Slope=.001
Kutter's Formula, n=.012 Concrete Pipe—n =.015 Clay Brick or Segmental Block

Internal Diameter in Inches	Water Area in Square Ft.	Discharge Concrete Pipe Sewer Cu. Ft. Per Second	Discharge Clay Segment Block or Clay Brick Sewer—Cu. Ft. per Second	Percentage Discharge Concrete Pipe over Segment Block or Brick Sewer
24	3.14	7.79	5.97	30.5
27	3.98	10.74	8.25	30.2
30	4.91	14.28	11.00	29.8
33	5.94	18.47	14.26	29.5
36	7.07	23.40	18.03	29.4
39	8.30	29.05	22.5	29.3
42	9.62	35.49	27.42	29.1
45	11.04	42.63	33.1	29.0
48	12.57	50.52	39.3	28.6
51	14.19	59.58	46.4	28.4
54	15.90	69.19	54.1	28.1
57	17.73	80.08	62.58	27.9
60	19.64	91.69	71.9	27.5
66	23.76	118.21	92.9	27.3
72	28.27	149.00	117.3	27.1
78	33.18	184.17	145.1	27.0
84	38.48	223.98	176.7	26.8
90	44.18	268.60	212.5	26.5
96	50.28	318.74	252.4	26.3
102	56.75	375.08	296.8	26.1
108	63.62	434.52	345.4	25.9

Note—Percentage of discharge of concrete pipe over brick or segmental block sewers is independent of the gradient or slope. For example, this percentage will remain constant in the case of a 48-in. pipe whether it is laid on a 1% grade, 0.1% grade, or .01% grade. The above calculations were based on a slope of .001, which corresponds to a 0.1% grade.

Labor Is What You Make It

"It always makes me sore when I hear managers of factories, either concrete products plants or other plants, carry on about how useless labor is these days," says 'the Old Man' in *The Idealist*. "There is a certain type of man who takes particular delight in holding forth on this subject. Personally, I usually set him down as a man who does not know how to run a plant. I believe labor is not very much different today from what it was forty years ago. Probably at that time certain men carried on exactly as the same type of man does now, and told everybody how much better labor was before the Civil War.

The amount of interest that the average man takes in his job, is entirely dependent upon the attitude of his employers. As far as we have found, nine out of ten men do the right thing if you give them half a chance. In the concrete products industry in particular, we usually find in a well-run plant there is a very cordial relationship between the owner and the employee, and the men in the plant not only take pride in getting as high a production and as high a quality as possible, but they are always glad to tell of records they have established with the equipment. They seem to regard their work in the nature of a game, and to get a certain amount of pleasure out of it, in addition to their day's wages. It is this attitude of taking pride and pleasure in their work that makes a successful plant. Of course this whole attitude is fostered by the employer or manager, and depends upon his efforts to make it thrive.

Exchange your construction "kink" for the other fellows' "kinks" in CONCRETE.

Architects and Industrial Building

How a Big Concrete Contractor Gets Jobs

By J. P. H. Perry
Vice President Turner Construction Co.
New York City

In the course of an extended contracting experience which covers the construction of nearly 800 industrial buildings the writer has been convinced that, broadly speaking, the industrial executive is better served when he employs an architectural engineering concern than when he goes it alone and deals directly with the contractor. This does not apply to the big industrial concerns who have their strong engineering departments because in these instances they are practically employing architectural engineers. It is fundamentally a mistake to make the contractor act as architect, engineer and contractor. The two points of view of architect and contractor are too different. Stated purely selfishly from the contractor's point of view, the contractor would prefer to have an architectural engineer between himself and the owner. If the European nations have found the need of buffer states, certainly the average contractor is very glad to have a presumably disinterested technician between himself and the owner. The larger architectural engineering concerns with long records of successful designing behind them, dipping into many different kinds of industrial activity and dealing with all phases of the problems of construction, maintenance and operation of industrial buildings, bring to an owner a knowledge, skill and judgment which it is almost impossible to secure in any other way. The owner who tries to save his architectural fee is often penny-wise and pound-foolish.

It is quite true, however, that the architect is not as important a factor in industrial building construction as in many other types of building work. In fact, in many instances the architect is not a factor in the building of a factory or warehouse. Again, he will be found to have full control of such a project. It is interesting, therefore, to determine on a basis of experience the relative control exercised by the architect in this field; his position and function relative to the individual project; and the reasons why in many instances architects are not employed for industrial work.

There is one condition which obviously will often eliminate the architect and that is the special nature of many of the industrial buildings erected. It is only necessary to consider for a moment the construction of foundries, bakeries, bleacheries, textile mills, cold storage warehouses, tanneries, ice-making plants, paper mills, abattoirs, breweries, meat-packing plants, cement plants, docks, sugar mills, etc., to appreciate the highly specialized knowledge necessary for the successful design of these buildings. It is not strange then that the owner frequently deals directly with a consulting engineer or even with a contractor who has had experience in these special classes of buildings.

Another general condition prevails which results in the architect being by-passed by the owner and that is the fact that many of the industrial concerns of the country have developed strong engineering departments of their own and believe that these departments can efficiently design and supervise the construction of their industrial buildings. Such concerns as the American Can Co., American Woolen Co., Armour & Co., Swift & Co., Colgate & Co., Alexander Smith & Sons Carpet Co., Procter & Gamble, Eastman Kodak, P. Lorillard & Co., Aluminum Co. of America, Great Atlantic & Pacific Tea Co., Standard Oil Co., American Agricultural Chemical Co., Vacuum Oil Co., Scoville Mfg. Co., Endicott Johnson Co., Diamond Match Co., are among the many industrial leaders of this country who use outside architectural service only under special circumstances.

Dollars vs. Design

There is still another angle to the situation which is at times a factor in cutting out the architect and that is the opinion which, while undoubtedly odious to the architects, still prevails among many industrial executives and that is that their buildings do not need architectural treatment and that architects as a class tend to spend more money in beautifying buildings than is warranted and that architects are more interested in the appearance of a job than in its sufficiency as an operating unit. The industrial executive is usually more concerned about the dollar return on his building than he is with its appearance. This condition results in constant pressure on contractors who specialize in industrial building work to design as well as build and while most leading contractors conscientiously endeavor to persuade industrial executives to employ architects or engineers, there are cases where the contractors take work directly from the industrial owner.

The fact that many contractors specializing in industrial building work have spent and are spending large sums of money in national or local advertising campaigns has accounted for the direct contact between the contractor and the owner in many cases. Theoretically the architects are not supposed to advertise and very generally they do not. It is not to be wondered, therefore, that full page advertisements in the *Saturday Evening Post* and weekly advertisements in the great newspapers of the country as well as intensive use of photographs and catalogs aimed directly at the industrial executive by the leading contractors and material men in the industrial field, have brought a response of inquiries directly to the contractor. Often these result in mutual confidence and real business, particularly where the building is but a shell or weather-stop and the heart of the development is a great machinery installation which is first and foremost in the owner's eye.

From the *Forum Bulletin*

AVERAGE ANNUAL CONSTRUCTION OF INDUSTRIAL BUILDINGS
For 27 States—1919 to 1922, Inclusive
Data Based on F. W. Dodge, Inc. Statistics
Arranged in Order of Importance

		Av. Annual Construction	Projects in Or. of Size
1.	Metal Working	$113,137,812	7
2.	Garages (Service Stations, Pub.)	73,922,858	28
3.	Warehouses and Storage	58,236,935	23
4.	Textiles, including Cordage, Dyeing, etc.	30,397,325	11
5.	Electric Power	27,971,500	1
6.	Rubber Working	19,495,325	18
7.	Paper and Pulps	13,596,975	8
8.	Lofts	11,357,425	6
9.	Ice and Cold Storage	10,868,602	22
10.	Wood Working	10,433,750	20
11.	Printing and Binding	7,357,230	14
12.	Confectionery	7,323,100	13
13.	Oil Mills, Refineries	7,174,844	12
14.	Bakeries	6,005,875	25
15.	Packing, Slaughtering, etc.	5,565,575	19
16.	Chemicals, Dyeworks, Explosives	5,536,885	10
17.	Cereals	5,516,750	4
18.	Boots, Shoes, Leather, Tanneries	5,489,400	16
19.	Creameries, etc.	5,434,795	26
20.	Glass Working	4,438,675	3
21.	Laundries and Cleansing	3,187,513	27
22.	Clay Working, Pottery and Bricks	2,988,000	5
23.	Cement	2,895,225	2
24.	Paints, Varnishes and Colors	2,717,450	21
25.	Breweries and Bottling	2,234,775	24
26.	Canning and Preserving	2,148,200	15
27.	Stone Working	1,436,850	17
28.	Fertilizers and Phosphates	1,363,075	10
	Miscellaneous	77,203,840	

From the point of view of the manufacturer seeking the building market, a list of the leading architectural engineering concerns who specialize in industrial building work can readily be prepared and their offices cultivated by personal solicitation and careful cooperation as well as by advertising. Advertising literature should be sent not merely to the heads of the firms but to their second and third string men who often are powerful factors in specifying materials or in the selection of contractors. It is only necessary to mention such firms as Lockwood, Greene & Co., Monks & Johnson and Charles T. Main in Boston; C. R. Makepeace and F. P. Sheldon in Providence; Fletcher-Thompson of New Haven; William Higginson, Timis & Chapman, Francisco & Jacobus, Russell G. Cory, C. B. Comstock, George F. Hardy in New York; The Ballinger Co. and Day & Zimmermann in Philadelphia; Albert Kahn and Smith, Hinchman & Grilles in Detroit; the Baxter Engineering Co. in Buffalo; Hunting-Davis Co. in Pittsburgh; the Osborn Engineering Co. in Cleveland; J. E. Sirrine in Charlotte; C. W. Roberts in Atlanta and R. L. Cummings in Houston, Texas, to indicate the class of firms who lead in industrial building design. Of course, this list might be greatly expanded to include many of the prominent general architectural firms who occasionally do industrial buildings, but where the industrial job is the exception rather than the rule it is a poor place to start intensive industrial cultivation for those trying to sell this particular field.

For the big majority of industrial building work, however, different selling campaigns have got to be considered. This general field divides itself into three broad cases:

1. The larger industrial concerns who have their own architectural engineering departments.

2. The great number of miscellaneous smaller concerns who build once in a decade and then frequently want to eliminate the architect on the grounds of economy and deal either with the general contractors or with concerns selling special building material and get them to work out a few sketches which can be the basis either of the competition or of a non-competitive contract.

3. An almost equally large number of industrial concerns who instead of employing the leading architectural engineering concerns such as those listed in a previous paragraph, engage architects who have built houses or schools with which they are familiar and who have little or no industrial building design experience.

The first class, namely, those with architectural engineering departments, are not difficult to list. The few names given in the first part of this article should stimulate anyone's imagination in the right direction. The chief engineer or the mechanical superintendent in charge of new building work, in the writer's experience are very approachable, very able, fair and businesslike. All they want is to be shown. While in general the chief engineer or mechanical superintendent does not actually award the business, his recommendations are of vital importance. If you have got him with you, you have pretty nearly got the job. The managing executives who give out the actual awards usually lean upon their engineering staff for guidance though it is true that a great deal of building business is gotten directly from the industrial executives.

For the second class, namely, the wide field of small industrial concerns, general advertising and general mailing are about the only ways to reach them. Their number is almost legion and any house-to-house or doorbell ringing campaign or personal solicitation is very nearly like looking for a needle in a haystack.

Any Buildings Today?

The concern with which the writer is connected has several times in the past twenty years during periods of depression conducted extensive doorbell ringing campaigns. In 1921 nearly 3,500 calls were made by a group of twenty employees who at the time were more or less surplus organization. Out of these 3,500 calls about 2,600 interviews resulted. One hundred and ninety-eight prospects were dug up, of which six actually built buildings, no one of which our company secured. In 1915—904 calls were made, four prospects dug up and no jobs secured. As a general rule our company has given up doorbell ringing.

For the third class, that is, the smaller architectural concerns and firms with little or no experience in industrial building work, the securing of business along contracting lines at least depends often upon the amount of cooperation which the contractor can offer the architect. The architect usually does one of two things—turns to the leading firms and puts himself in their hands to a considerable extent for information and endeavors to interest his client in selecting the bidders on quality rather than on a price basis, or failing this, he holds a rigid competition and buys solely on price. To reach these men, lists of architects being available, house-to-house canvass and solicitation is effective, direct mailing is effective, personal contact can be established, architects taken out to visit work done and their confidence secured in this way. One never knows where the lightning is going to strike on this class of work. Attractive jobs come up in charge of architects and engineers who have perhaps never had this class of work before. The seeking out of these men prior to their having real jobs and the acquainting them with the selling arguments is in the larger metropolitan districts a difficult thing to do economically. The architects are so much sought after by material and supply men of all types that house-to-house canvassing seldom results in benefit. These architects are often too busy with non-industrial work to bother with the industrial salesman except at the moment when they have an industrial job.

On the other hand, in selling industrial buildings our experience has been that by exercising reasonable judgment it is possible to separate the wheat from the chaff to a considerable extent. In the year from June 1, 1922, to June 1, 1923, our company made 569 estimates in its five offices. Of these 219 were approximate only and 350 were quantitative estimates or real bids. From these estimates 81 contracts were secured or a little over 14% of all the estimates made, both approximate and real, resulted in actual business placed on our books. Of the 569 estimates made 277 jobs actually went ahead. Out of these 277 jobs that actually went ahead we secured the 81 already referred to. In other words, our Estimating and Selling Departments were able to pick out of all the prospective estimating offered to us 48.7% of potential business and were able to actually secure and sign up out of the jobs that actually went ahead 29.3% which is a very fair average. This ability to distinguish real prospects from others is the result, of course, of a wide experience in dealing with the industrial building market almost exclusively. This would perhaps be generally admitted as a high factor of business secured, namely, somewhat better than one out of every four jobs figured and which actually went ahead and is the result of a continued advertising campaign hooked up with very careful personal solicitation and aggressive selling combined of course with a constant policy of doing the very best work that it was possible to do.

It may be interesting to have a look at some figures our company recently prepared showing how prospects originated. A study was made of the period from Oct. 15, 1922, to July 15, 1923 (nine months), of records very carefully kept which showed just how prospective new buildings were first heard of. In this period 368 prospects appeared. These prospects originated in the following ways:

1. Through wholly original and unsolicited inquiries on the part of prospects, 103.
2. Through inquiries coming either from former clients or at the suggestion of former clients, 54.
3. Through inquiries from architects, 101.
4. Through following newspaper clippings by sales engineers, 42.
5. Through following Dodge or Dow or Browns Letters construction reports, 9.
6. Following tips from friends of individuals within the company, 45.
7. Original inquiries from real estate brokers, 11.
8. From doorbell ringing on the part of sales engineers, 3.

A glance at the foregoing will show that one-third of all the new prospects with which this company was in touch for a period of nine months originated through architects. This figure might have been higher but for the fact that a great many of the original unsolicitated or friendly tipped-off prospects had their own plant engineer or consulting engineer.

Of these 368 prospects 58 thus far gave this company 58 signed contracts, equal to 16%. Of these 58 signed contracts which resulted from 368 prospects, 7 or 12% came from prospects which had been called to our attention through the architects. Fifty-one or 88% came from inquiries the source of which is in no way connected with or inspired by architects. This does not say, of course, that of the 58 contracts only 7 had architects on them. Practically all the jobs had either architects or owner's engineering departments steering the work.

It is believed that the foregoing figures are authoritative and should be convincing evidence of the importance of sales managers endeavoring to reach the owner of industrial buildings direct. At the same time the vital importance of cultivating the architectural field in this industrial building game cannot be overlooked for a moment. The architect when a factor is a tremendously powerful one, and as better and more monumental factory and warehouse buildings are built the architect will increasingly dominate the situation.

Architects Have Done Best Jobs

I do not want to close this article without making note of the fact that there is not much doubt that the very finest industrial buildings which have been built in the last ten years in this country, the finest in general effectiveness as well as in appearance, have been produced under the direction of architects. A certain distinctive appearance and a certain completeness of design and a more perfect interior arrangement and a general suitability, seem to prevail when the bigger industrial buildings are handled through an architect's office than when an architect is not in the picture. The work of the firms whose names are quoted in this article takes first rank among industrial buildings in this country. These men and others like them are a tremendous factor in industrial building construction and it can hardly be questioned that their influence is being more largely felt every year.

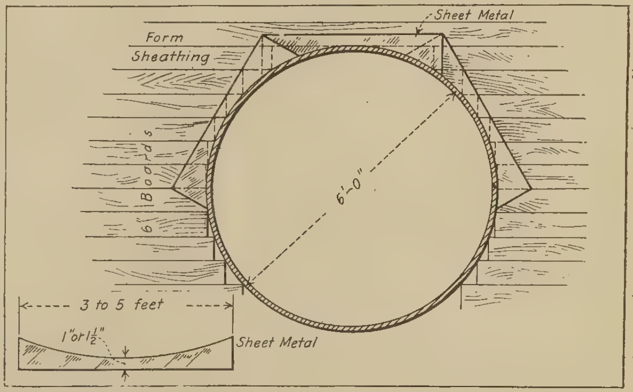
A Useful "Kink" in Building Forms

Courtesy *Contractor's Atlas*

Today when form costs run high even at best, any method which will save time and labor is well worth considering.

In a job involving the installation of two large water supply tanks of steel, H. W. Eldridge, an engineer and contractor of New City, N. Y., developed a useful way of fitting the formwork around the tanks.

The two tanks were each 30 ft. long and 6 ft. in diameter, supported at each end by concrete walls. In order to make a neat job of the formwork so that the concrete would have a good appearance, it would have been necessary to spend considerable time cutting and fitting the boards to the circle of the tank—in fact, to do a very good job would have meant cutting the ends on a band saw. To do away with the fitting operation, sheet iron plates cut to the proper radius were used to make a tight fit around the tank. These pieces each forming part of the required circle were cut from scrap pieces of black iron of about 18 gauge by the local sheet metal worker. The form boards were cut with square ends, nailed to the studs in such a manner that the space between the square end of the form board and the outside of the tank was not over 2 in. The sheet iron pieces were tacked to the inside of the form. The sheet iron pieces were of varying lengths, depending on the scrap available. The only fixed dimension in the piece of sheet metal is the proper radius and the provision of at least 2 in. at the narrowest portion. This method resulted in a saving of $4.00 per cu. yd. of completed concrete on this portion of the work.



How Slab Forms Were Fitted to Circle

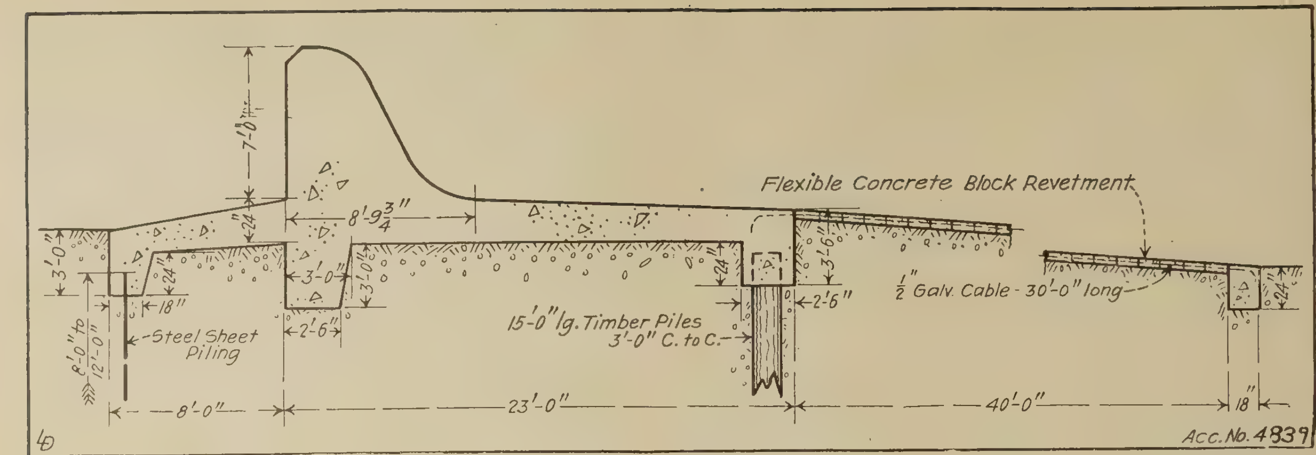


Fig. 1—Cross-Section of the Barrier Dam at Hamilton

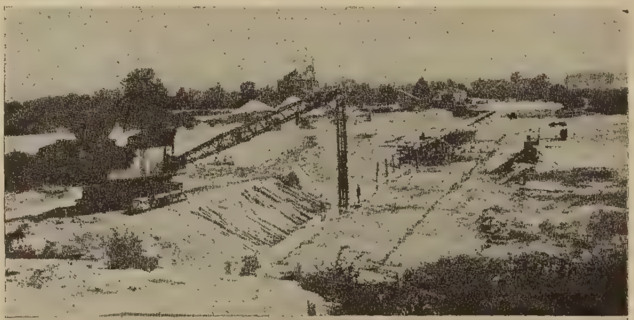
Overflow Dam Stops Drifting Gravel

A concrete overflow dam built across the Miami river at the upper end of the river improvement at Hamilton, Ohio, forms a barrier to prevent gravel from drifting down into the improved channel through the city, there to form bars that would be expensive to remove. As long as rivers continue to flow, they will carry along with them silt and gravel, especially at times of high water. The heavy gravels and sands, which are most troublesome of all the materials carried along by the water, travel on the bottom of the stream. A depression in the bed, plus a slight check in the velocity of the stream, will cause the materials to drop into the depression and stay there until the pit is filled. This dam will check the velocity of the Miami, and the basin above will form the pit in which the gravel and sand will drop. A sand and gravel plant will excavate the deposited material, screen it, and sell it for building material, and thus put a bad habit of the Miami river to beneficial use.

Reference to Fig. 1, which is a cross section of the highest section, will give the principal dimensions. The dam is built on a pervious foundation. The central part is an ogee weir, and is a gravity section,—that is, it will stand up against the tendency of the water back of it to overturn it, without reinforcing steel. The broad aprons give it added stability, especially against the tendency of the water to push it downstream. The wide base also forces the water percolating through the pervious foundation under the dam and creeping along the lower side of the concrete to travel a considerable distance between the upper and lower toes. Head, which is nothing more than potential energy, is used up in forcing the water through the voids in the gravel. The longer the distance, the more head is used. Much of the destructive energy of the water is thus used up in friction, and the velocity of the percolating water is cut down so much that the material under the dam is not displaced or washed away. The cut off walls and the sheet piling at the upper toe help in this by adding to the distance the creeping water has to travel, and by giving some right angle turns to the direction of the creep. They also help anchor the dam in place. The wooden piles at the lower toe also serve as an anchor to the dam and to the flexible mat and in case of a washout at the toe, will hold up the apron. The wide flexible mat of concrete blocks (see Fig.3), at the lower toe, is a protection for the toe of the dam against the scouring action of the water as it falls over the dam, and shoots with high velocity over the smooth concrete apron.

The abutments, built against the natural banks of the stream, vary in thickness from 36 in. at the bottom to 12 in. at the top. The east abutment is on a 2 : 1 slope, and the west one is a 3 : 1 slope. Both abutments are supported by toe walls 3 ft. thick, which in turn are supported by a row of wooden piles 3 ft. apart. The foundation material is sand and gravel, similar to the material under the main dam.

The aprons are reinforced with ¾-in. iron bars, laid 18 in. apart, and running up and down stream. The upper apron caps the tight wall of sheet steel piling, the lower apron caps the wooden piling. The cables for the flexible mat are anchored into the toe of the downstream apron. The concrete block mat is composed of the same kind of blocks that are used to protect the toes of the levees, and is laid in a similar manner.



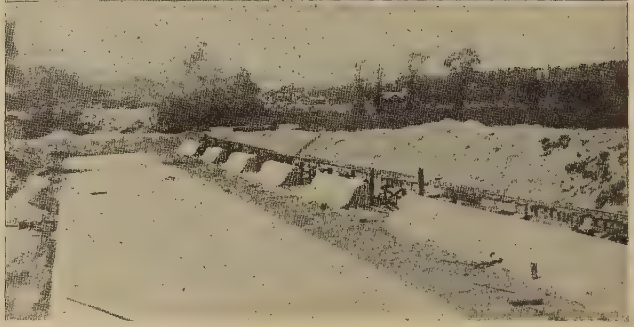


Fig. 2—General View of the Barrier Dam at Hamilton, September 23, 1922

The first section had been completed and the river turned through the five gaps when this view was taken. The cofferdam around the remainder of the dam had been built, and the water pumped out. The drag line in the foreground was engaged in driving piling with the leads and hammer of the pile driver suspended from the end of the boom. The trestle carried the narrow gauge track used in the transportation of the concrete from the mixer to the forms.

Fig. 3—The First Section of the Barrier Dam at Hamilton, August 22, 1922

The cofferdam was still in position. The five gaps in the spillway section were used to carry the river while the remainder of the dam was under construction. The trestle carried the track used in transporting concrete from the mixer to the forms.

Some of the methods used in building the Black street bridge were employed to advantage. A dragline excavated one-half of the foundation, threw up an earth dyke around the excavation, and did the pile driving just like similar work was done at Black street. An 8-in. centrifugal pump unwatered the pit, and had to run less than one-half the time to keep the water down. A wooden trestle was built just above and 2 ft. higher than the upstream crest of the dam. (See Fig. 2). Narrow gauge track was laid, and concrete cars were handled over it by gasoline locomotives. The concrete mixing plant was on the bank. The foundation and the aprons were poured ahead of the spillway section, with joints every 30 ft. to provide for expansion and contraction. Beginning at the east end 90 ft. of the spillway section was run in three 30-ft. sections. Then alternate sections 30 ft. long were poured, leaving gaps 24 ft. long between, until five gaps were formed.

Then the coffer dam was cleared away, and the river was turned through the five gaps. Then the foundation for the remainder of the dam was dug, a dyke thrown up around it, the water pumped out, and the concreting opertations repeated, save that no further gaps were left out.

When the last half was completed, the coffer dams were cleaned up. The dam was now completed save for the five gaps. These were closed one at a time. A small timber coffer dam on the upstream side shut off the water until the section could be filled with concrete.

When the last section was reached the water was very low in the river. After the opening was closed by the timber bulkhead it took 60 hours for the water to rise to the top of the dam. This allowed sufficient time for completing the forms, pouring the concrete and removing the forms. On this last section a hand pump was used to remove the water between the forms and the timber bulkhead, until the concrete had been poured and set up.

An average day's work was 100 cu. yds. On the abutments and on the end walls for the flexible mat a small mixer and wheelbarrows were used. Work was started June 1, 1922 and was completed November 9. There are about 3,000 cu. yds. of concrete and 16,000 blocks in the structure.

For the above information CONCRETE is indebted to the *Miami Conservancy Bulletin.*

How Sgraffito Decoration Is Done

By S. Brian Baylinson

Associate, Frank E. Hahn, Architect & Engineer, Philadelphia, Pa.

Courtesy *Contractor's Atlas*

The exterior sgraffito decoration has been used for many centuries as a means of architectural embellishment; its more general use today is perhaps avoided in smaller work because of an unwarranted belief that the process is a complicated one and the expense of execution prohibitive. In addition, an element of uncertainty as to lasting quality sometimes is held by those who have not made use of its very colorful possibilities.

Many of the old Italian sgraffito facades subjected for centuries to the excessive heat and heavy rainfall of Italian climate, bear witness to the fact that sgraffito work, properly executed, is most lasting and durable. This is true in a great many cases, where on the same building stone and marble show decided signs of deterioration.

It is surprising just how much can be done at a comparatively small expenditure. The splayed panel forming the entrance motive to the Bains Luggage Shop, here illustrated, cost $400, exclusive of the structural foundation.

If proper materials are embodied in the specification, such as a good pure white stainless portland cement, a true even coloring compound and a substantial foundation, together with capable workmanship, a most satisfactory result is assured.

A Satisfactory Specification

The following short specification has been found to be a very satisfactory one:

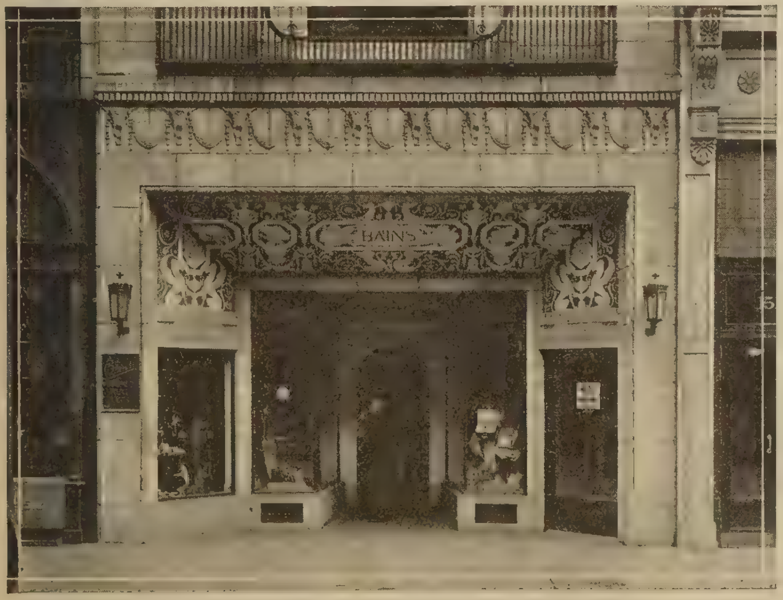
Erect backing of expanded metal lath and channels, including all rod hangers, etc., required to amply support same.

Then apply scratch coat of cement mortar composed of Atlas white non-staining cement and screened washed white, sharp sand, evenly applied and scratched. Apply a second coat of Atlas white non-staining cement and white sand as above, evenly applied and left ready for finishing sgraffito work.

Upon the cement plaster base apply one coat of cement plaster composed of Atlas white non-staining cement and screened white sand thoroughly washed and sharp.

This coat to be ¼ in. thick, evenly applied and tinted a warm sienna using an approved color pigment.

Before this tinted coat has entirely set, apply a coat of cement plaster composed of Atlas white cement, white, sharp sand, thoroughly washed, and marble dust. Place the stencil previously cut over background prepared as above and carefully trace design shown, removing all cement coating outside of design and back to and exposing the ground or sienna first coat, leaving design in relief. The surfaces of the design to be given sufficient scratch modeling to avoid harsh lines. Do not, however, make the mistake of modelling design as this will entirely destroy the character of the ornament.



A Shop Front with Sgraffito Enrichment

Tell Concrete how you got a job safely through a cold snap, what precautions you used and what they cost.

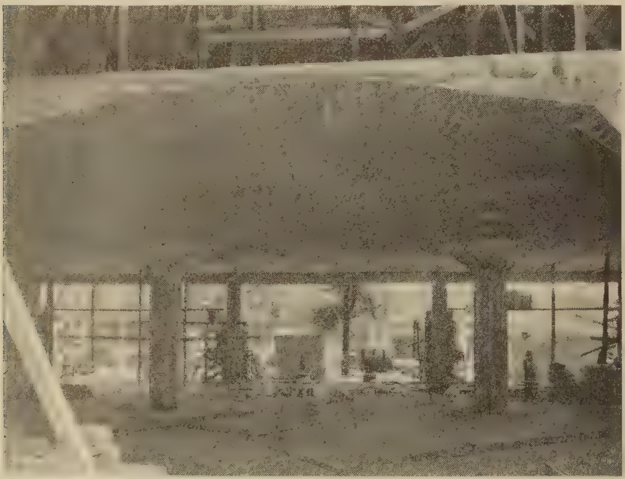
Unit Slab System Permits Long Exterior Spans

The accompanying illustrations show some of the features of the Foster Unit Slab system of reinforced concrete construction described in the July, 1923, issue of CONCRETE. The system is based upon the principle that concrete has no tensile strength in a structure but that it makes good compression members. It is claimed that the unit slab system puts all the concrete in compression and depends upon the steel alone to withstand tension.

Fig. 1 shows a section of the Buick show room in Flint for the General Motors Corporation. An entire section of the floor is carried without a girder. The view is from a stair landing. Fig. 2 shows a view from the same point 40 days later and gives an idea of what can be done in the way of decorative treatment without extra expense.

Fig. 3 shows a portion of the third floor with large areas of the roof removed and monitor lights built above without any special girder or other arrangements to carry the load. This picture was taken with the camera set back more than 150 ft. from the rear wall and without any artificial light. The ceilings are shown just as they were stripped. The outside walls are carried by columns set back 15 ft. from the walls. Bays back of the girder through the center are 37 ft. on centers.

Fig. 4 shows the 100-ft. span without supports, the columns being set back 15 ft. from the edge of the building.



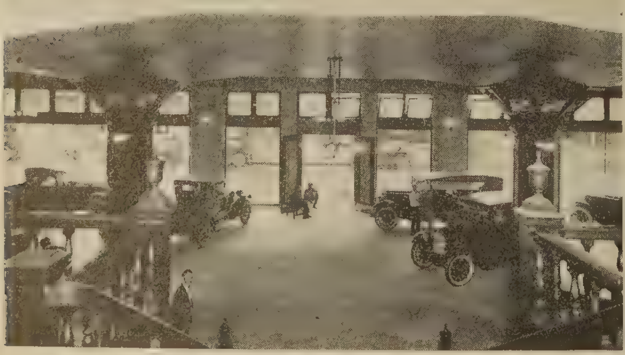
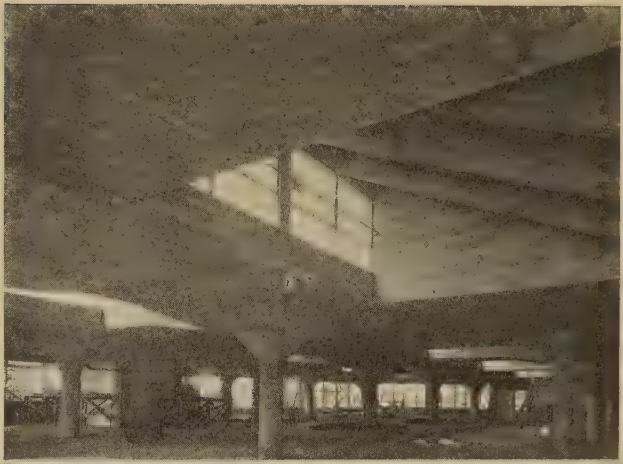


FIG. 1—BUICK AUTOMOBILE SHOW ROOM UNDER CONSTRUCTION AFTER THE FOSTER UNIT SLAB DESIGN

FIG. 2—SAME VIEW 40 DAYS LATER SHOWING HOW THE SYSTEM LENDS ITSELF TO ARTISTIC DESIGNING



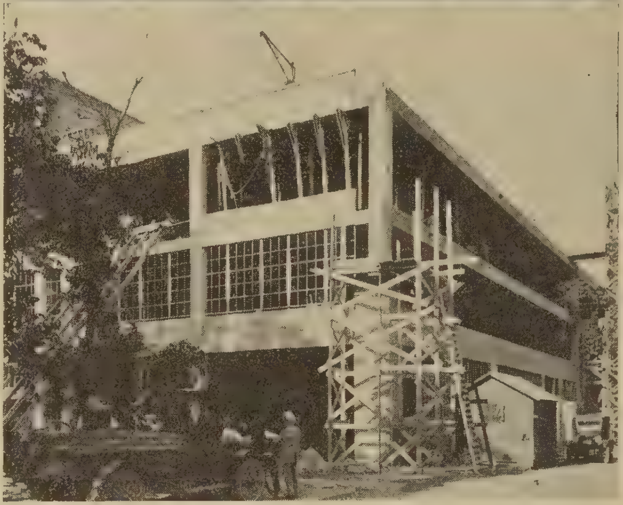


FIG. 3—LARGE AREA OF ROOF OF BUILDING REMOVED FOR MONITORS WITHOUT SPECIAL GIRDERS

FIG. 4—SPANS 100 FT. LONG WITHOUT SUPPORT IN OUTER WALLS. COLUMNS ARE SET BACK 15 FT. FROM THE EDGE OF BUILDING

Fire-Resistive Classifications for Walls and Partitions

It is interesting to review what has been reported by the Underwriters' Laboratories, Chicago, as to the resistance of concrete to fire and water tests on walls and partitions, conducted by the laboratories. Fire-resistive classifications on a time basis have been assigned as a result of the tests. If a wall panel of a certain material or type of construction is subjected to the standard fire test used by the Underwriters, and the several specimens withstand the test for an average period of 3 hours and 45 minutes, this particular material or construction is then given a classification of about 80% of the average, or 3 hours, designated as R-3 hr. This does not mean that all other walls of a similar material or form of construction will be accorded an equal classification, unless there is satisfactory proof or assurance that such walls were built in accordance with the specifications used in constructing the test wall.

It is the intention of the Underwriters, eventually to publish in a separate booklet the results of tests of walls and partitions and the classifications assigned to the various materials and forms of construction. For the present, however, this information appears in the 128-page pamphlet entitled "List of Inspected Mechanical Appliances," issued semi-annually by the Underwriters' Laboratories.

The following paragraphs contain statements of fire-resistive classifications accorded to several materials and forms of concrete or cement mortar construction. The specifications in the paragraphs immediately following are taken verbatim from the Underwriters' "List of Inspected Mechanical Appliances," in order that those interested in this matter will have at hand the specifications under which the test panels were built.

(a) *Hollow 12-inch Gunite Exterior Walls*[1] (Non-bearing, as for curtain walls in skeleton constructed buildings). Accorded fire-resistive classification of *3 hours.* Submitted by Cement Gun Co., Inc., Allentown, Pa. Field inspection service.

Exterior walls of two Gunite slabs, integral with and stiffened by solid Gunite reinforced studs. Slabs and studs anchored at all edges of the wall to load bearing steel or reinforced concrete units (columns, girders and beams) of the building frame. Gunite slabs at least 2 in. in thickness are built up of portland cement and sand applied by a cement-gun and are reinforced with No. 13 gauge expanded metal (1¾-in. mesh). Gunite studs 6 x 8 in. are of portland cement and sand, also applied by a cement-gun reinforced by two ¾-in. rods and are spaced to limit the span of the Gunite slabs to 4 ft. minimum and 7 ft. maximum. Lumber and saturated felt used as centering and remains in the hollow spaces of the completed wall. Lintels and sills at openings of construction similar to studs.

Load bearing units of the building structure must be provided with equivalent fire protection to develop the full retardant value of this construction. Classification R-3 hr.

(b) *Hollow 12-inch Gunite Interior Walls* (Non-bearing, as for corridor walls in skeleton constructed buildings). Accorded fire-resistive classification of *3 hours.* Submitted by Cement Gun Co., Inc., Allentown, Pa. Field inspection service.

Interior walls of two Gunite slabs, integral with and stiffened by solid Gunite reinforced studs. Slabs and studs anchored at all edges of the wall to load bearing members (walls, columns, girders and beams), of the building structure. Gunite slabs, at least 2 in. in thickness, are built up of portland cement and sand applied by a cement-gun and are reinforced with No. 10 to 14 gauge expanded metal of about 2 in. mesh or other steel fabric of equivalent area and strength. Gunite studs 6 x 8 in. are of portland cement and sand also applied by a cement-gun reinforced by two ¾-in. rods and are spaced to limit the span of the Gunite slabs to 4 ft. minimum and 7 ft. maximum. Lumber and saturated felt used as centering and remains in the hollow spaces of the completed wall. Lintels and sills at openings of construction similar to studs.

Load bearing units of the building structure must be provided with equivalent fire protection to develop the full retardant value of this construction. Classification R-3 hr.

(c) *Solid 2-inch Gunite Exterior Walls* (Non-bearing). Accorded fire-resistive classification of *one hour.* Submitted by Cement Gun Co., Inc., Allentown, Pa. Field inspection service.

Exterior walls of a single Gunite slab integral with and stiffened by solid Gunite reinforced studs. Slabs and studs anchored at all edges of the wall to load bearing steel or reinforced concrete units (columns, girders and beams) of the building frames. Gunite slabs, at least 2 in. in thickness, are built up of portland cement and sand applied by a cement-gun and are reinforced with No. 13 U. S. gauge expanded metal (1¾-in. mesh). Gunite studs 6 x 8 in. are of portland cement and sand also applied by a cement-gun reinforced by two ¾-in. rods and are spaced to limit the span of the Gunite slabs to 4 ft. minimum and 7 ft. maximum. Lintels and sills at opening of construction similar to studs.

Structural units supporting this partition must be provided with equivalent fire protection to develop the rated retardant value of this construction. Classification R-1 hr.

(d) *Solid 2-inch Gunite Interior Partitions* (Non-Bearing). Accorded fire-resistive classification of *one hour.* Submitted by Cement Gun Co., Inc., Allentown, Pa. Field inspection service.

Interior partitions of a single Gunite slab integral with and stiffened by solid Gunite reinforced studs. Slabs and studs anchored at all edges to structural units (walls, columns, girders and beams) of the building. Gunite slabs at least 2 in. in thickness are built up of portland cement and sand applied by a cement-gun and are reinforced with No. 13 U. S. gauge expanded metal (1¾-in. mesh). Gunite studs 6 x 8 in. are of portland cement and sand also applied by a cement-gun reinforced by two ¾-in. rods and are spaced to limit the span of the Gunite slabs to 4 ft. minimum and 7 ft. maximum. Lintels and sills at openings of construction similar to studs.

Structural units supporting this partition must be provided with equivalent fire protection to develop the rated retardant value of this construction. Classification R-1 hr.

(e) *Straub 8-inch Solid or Hollow Cinder Concrete Block Wall* (Bearing). Submitted by Crozier-Straub, Inc., New York city. On the basis of fire and water tests on Straub hollow cinder concrete block conducted at the Underwriters' Laboratories in 1922, a 2½-hour classification was accorded to 8-in. walls of these block, with sides of wall unplastered.

Underpinning Without Shores

The method used in underpinning the New York Public Library known as "stealing" described in the *Engineering News-Record* depends upon the use of rammed mortar to transfer the load from the old footings to new concrete piers. The method is similar to that described in an article in CONCRETE,[1] in which dry tamped concrete replaced wedges in underpinning.

The extension of the Queensboro subway past the New York Public Library necessitated the underpinning of the north wall of the building as the bottom of the cut for the subway had to extend below the footings of the building. The old footings had to be underpinned before the cut was made, since they were spread footings, resting on hardpan, underlying which was rock of a decomposed nature, ranging in depth as much as 13 ft.

Excavation along the footing of the building was made with a steam shovel to a depth of about 2 ft. above the underside of the old footings. Following this excavation, holes 4 ft. wide were sunk along the side of the building about 30 ft. o. c. through the soft rock to a solid rock foundation. After the holes had been drifted back under the old footings for a distance of 6 ft. they were concreted up to form piers, the tops of which were 6 in. below the underside of the old footings. After the concrete in the piers had hardened sufficiently, the remaining space between the top of the pier and the old footings was filled with dry tamped concrete or mortar proportioned 1 cement to 2 sand and rammed in place by a thick wooden wedge and sledge hammer. Only enough water was used to enable the mortar to be molded into balls with the hand.

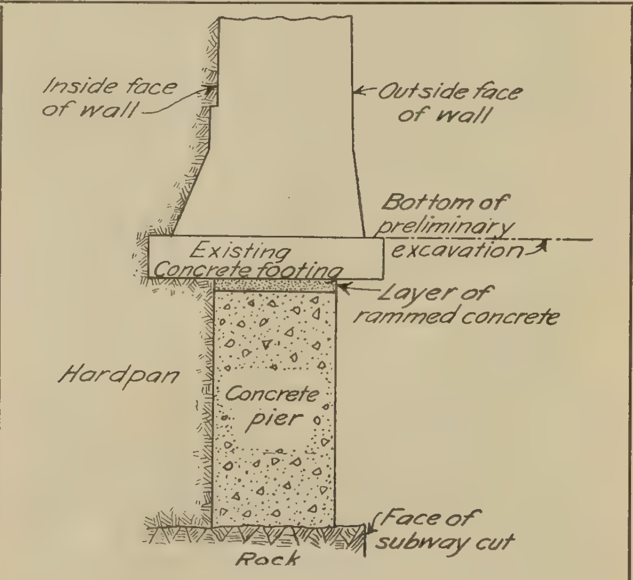


FIG 1—DETAIL OF TYPICAL PIER SHOWING DRY TAMPED CONCRETE

As the piers were built up, V-shaped recesses were cast in the sides to provide bond with subsequent work. Second and third rows of concrete piers were built in a similar manner and after the piers were sufficiently solid to support the entire load of the building, the intervening spaces were excavated to the solid rock foundation and a 3-ft. curtain wall built in so as to make a continuous foundation from the old footings to the solid rock.

---

[1] February, 1921, page 84, Dry Tamped Concrete Replaces Wedges in Underpinning.

Tests made before the work was started on samples of mortar mixed as specified for the 6-in. layer of rammed concrete showed that the material sustained a load of over 4000 lbs. per sq. in.

The underpinning was done by Jarrett-Chamber Co., Inc., New York city, under the general supervision of John H. Meyers, engineer 2nd Division, Transit Commission and Carrere & Hastings, Shreve, Lamb & Blake, architects for the library.

Failure of Binghamton School

A three-story school building under construction at Binghamton, N. Y., failed just after workmen had left it in the afternoon of September 18. The portion of the building which collapsed included an area in plan about 60 ft. x 75 ft., comprising the external wall and two interior walls from the roof to the basement.

No definite decision as to the cause of the failure has yet been reached according to the *Engineering News-Record*, due to the completeness of the failure and the danger of further collapse of portions of the front wall.

Preliminary investigations narrowed the possible causes of failure to two: premature removal of wooden supports from under fresh roof concrete and structural weakness of one of the interior tile bearing walls.

The support for the concrete floors and roof consisted of two 2-in. x 4-in. pine timbers spiked together in the form of "T's" and spaced on an average of 4 ft. 6 in. across the room and 5 ft. 6 in. along the room, each support carrying approximately 25 sq. ft. of floor load. The supports were from 13 to 15 ft. long and were supported at about mid-height by 1-x 8-in. braces in each direction. They were capped along the longest dimension of the room by 2x6's. About half the supports under the green roof concrete had been removed prior to the pouring of the roof.

It is pointed out that if failure occurred in any of the interior walls it was probably in the first wall inside the enclosing wall. This was 26 ft. in from the exterior wall and parallel to it and was constructed of 12-in. tile. It was pierced by numerous openings and also included the rather peculiar feature of a 30-in. concrete girder resting on it and extending partially along its top. The failure was so complete it will be difficult to decide which of these causes may have been responsible, if either.

Exterior walls of the building were of interlocking tile with a brick facing, and interior walls were of tile. Exterior walls were 16 in. thick from the basement to the first floor and 12 in. thick from the first floor to the roof, including the brick facing.

Specifications provided that the walls should be laid up in cement mortar and that in portions subject to heavy bearing, the tiles should be filled with concrete or the space laid up with brick.

Floors of the building were of the steel-pan concrete type, the pans being 10 in. and 12 in. covered with 2-in. concrete slabs.

Over the corridors, the pans were being removed for the most part for re-use. The first floor had been placed about three months and the second floor about six weeks at the time of the failure.

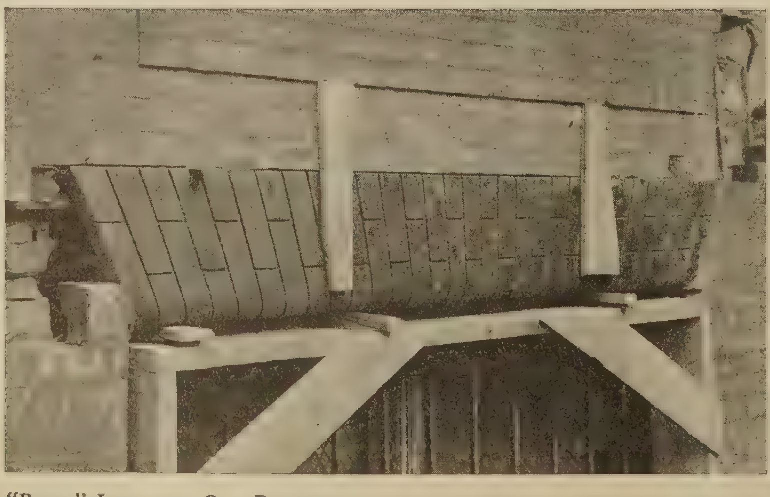
Construction work was started last spring by Kirkpatrick & Stento of Binghamton and was progressing in a fairly satisfactory manner. The building was designed by Dickerman and Bartoo, Binghamton architects who also were supervising the construction.

A Quick Way of Laying "Brick" Lintels

Courtesy *Contractor's Atlas*

In these days of higher labor costs laying up a brick lintel or arch is sure to be costly, out of proportion to its importance. It is one of those "fussy" jobs that consume a great deal of a man's time.

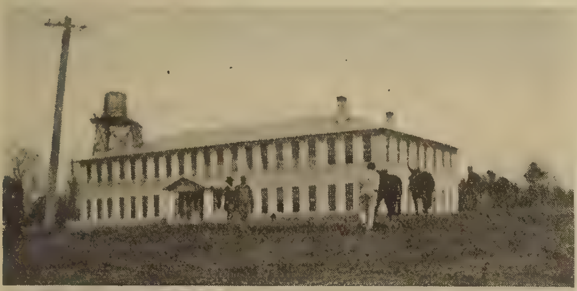
On a building in lower New York, where some alterations and repairs necessitated changing some of the window openings, it was necessary to place several lintels over window openings in the old brick walls. To do this in the ordinary way would have been quite troublesome, and the easiest solution was to employ an ingeniously molded concrete lintel. One of these lintels being set in place is shown in the photograph. The precast concrete is colored with mineral pigment to simulate almost exactly the color of the old brick work. Joints are cast in the concrete, and after the lintel is fixed in place, these joints are pointed up with mortar to match the old joints. In the photograph the joints are not yet pointed. In this case the brick walls are not bearing walls, but if they were the lintel could easily be made of such dimensions and so reinforced as to give all the necessary structural strength.



"Brick" Lintel in One Piece

Are you doing any winter concreting? What methods are you using to insure safe hardening of the concrete?

Concrete Construction in Piney Woods School



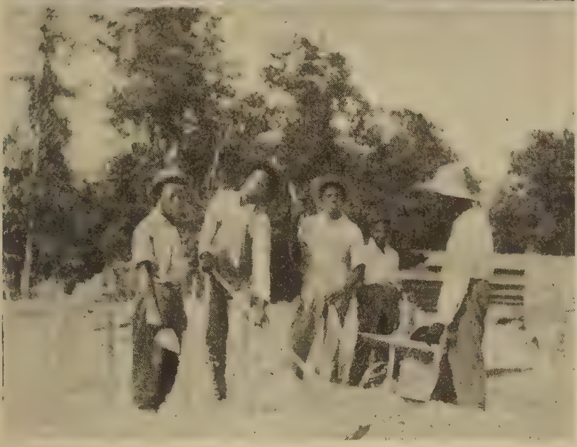


Fig. 1—Goodwill Hall, School and Administration Building

Fig. 2—Mixing the Mortar

The first classroom of Piney Woods School for negroes near Braxton, Miss., was a few logs rolled up under a cedar tree in an open field. The classrooms now are in fireproof buildings of concrete brick.

The teacher of the school was a young colored man who had determined that what his humble people in that section of the Black Belt needed was not to learn algebra and latin so much as it was to know how to raise better crops and cook better food. So he determined to have a school of that kind.

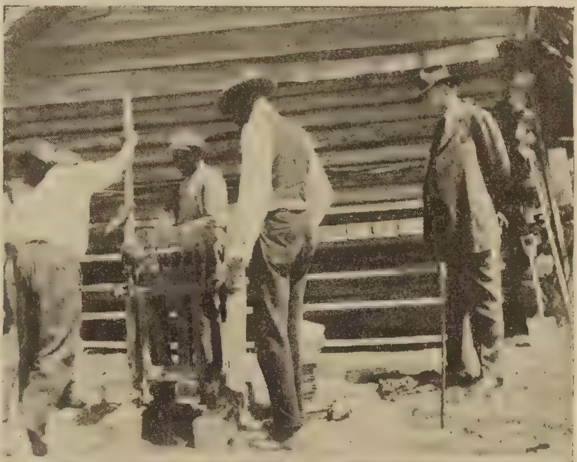
At the time this young teacher, Laurence C. Jones, did not own the land around the cedar tree and his capital consisted of $1.65. He had recently graduated from the University of Iowa and had come South with a determined ambition to help his own race. Practical education was the only philanthropy he could conceive that would be of service to them just then. So he set about to give them that.

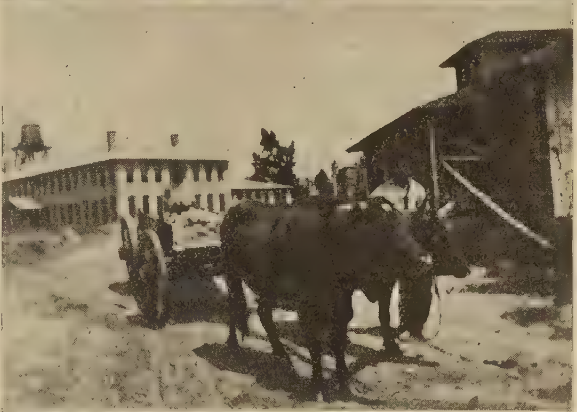
That was twelve years ago. The story of those twelve years is an interesting one full of struggles, the support and misunderstandings of white people, and always the unquenchable courage and purpose of the young principal and his wife. An increasing number of students entered the school, earning their way (not to pay teachers' salaries, for there were no salaries!), learning to raise more and better corn, better hogs, to make better gardens, brooms, baskets, and to sew and cook.

When the rough pine buildings which had followed the open-air schoolroom became too small, Jones began to look around for materials which would be more substantial and yet within reach of their struggling financial condition. First they tried making fire brick of the clay around them, but the clay proved to lack the constituents which make a first class brick. Then Jones bought a Helm brick machine and a few sacks of cement. With the sharp sand which abounds in their hillsides and with water from the abundant springs, he found they could turn out concrete brick which were entirely satisfactory in every respect. A 1:2 mix is now used.

The first building they put up with this brick was a girls' dormitory, 52 x 86 ft. They mixed lamp black with the concrete for this early building and made a darker brick but it seemed to have no great advantage so they abandoned it in the later product.

A year later Goodwill Hall (so named because contributions for its erection came from almost every state in the Union), was put up of the same kind of





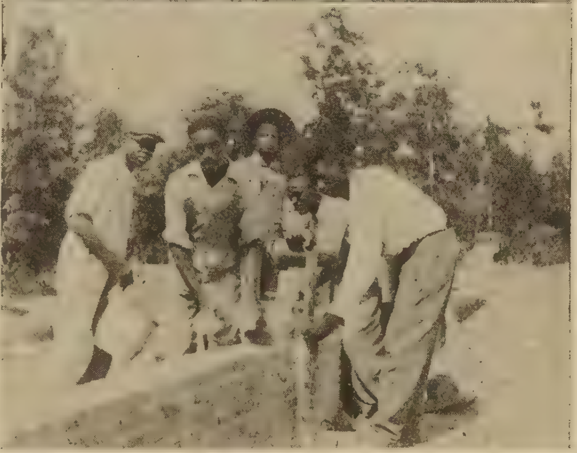


Fig. 3—Making the Brick

Fig. 4—School Boys Hauling Brick

Fig. 5—Boys Building Their Dormitory

brick. This is a chapel, 75 x 57 ft., with a two-story 100- x 49-ft. ell given over almost entirely to classrooms.

Concrete brick construction has proved so satisfactory that Piney Woods School is now putting up a boys' dormitory of the same material. Since their former boys' dormitory was lost by fire, their effort to make this one fireproof prompts them to build every partition in the building of concrete brick. The light, uniform color will make a pleasing interior.

A very limited number of the students in Piney Woods School have funds with which to pay even the $8 per month which is charged them for room and board, so most of them work their way. That means they must remain from May until October at the school to earn the privilege of attending classes (both academic and industrial) during the rest of the year. It is during these summer months that they put up their buildings. One crew of these dark-skinned fellows will be laying brick while others will be out in the woods getting timbers. In emergencies even the girls are pressed into service to carry brick and water.

The school has never had more than one hired worker at a time in the construction of its buildings, and he is always an experienced man who is to consider teaching the boys as important a part of the task as getting up the building.

There is efficient division of labor—while some of the students are working on buildings, others are farming. The girls cook, can wild berries, make clothing and quilts from materials in boxes sent from the North. The school still lacks many things—a church, larger and better living quarters for students and teachers. But its aim is not to build up a great institution—only a simple country life school that will make for better farming, better thinking and better every-days among those "who live back from the main-traveled roads."

Family Mausoleum, Asheville, N. C.

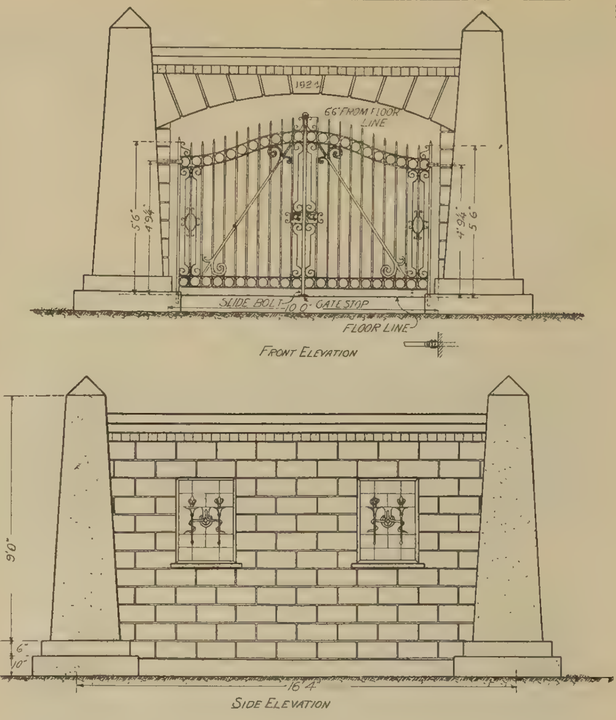
The accompanying details are of a family mausoleum designed by W. A. Whitfield, for construction in Asheville, N. C. The outside dimensions are 16 ft. 4 in. x 13 ft. 8 in., to be built of reinforced concrete with concrete block walls 8 in. thick, blocks to be faced with a white cement mix.

The crypt walls and floors are to be 4 in. thick of reinforced concrete, the dimensions of crypts being 2 ft. 8 in. x 2 ft. 4 in. x 7 ft. 6 in. long.

Crypt doors or seals 3½ in. thick are to be precast of a dimension to fit opening, and reinforced with metal lath and corrugated bars and paneled on the back to make them lighter in weight. Two edges are grooved and beveled in order to seal them with cement mortar. Four bronze bolts are cast in the seal to fasten on the marble slab, this slab being beveled on the edges and three inches larger in dimensions than the concrete seal.

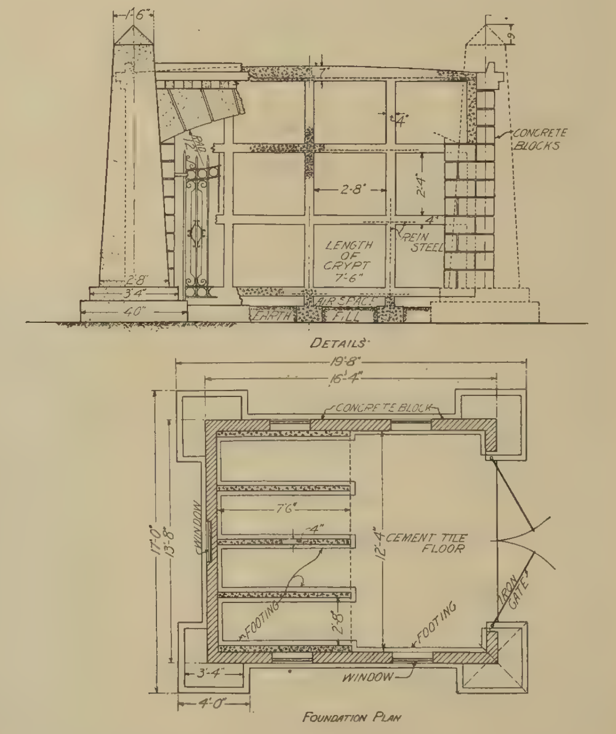
The obelisk, one at each corner, has a base 2 ft. 8 in. square tapering to 1 ft. 6 in. at top, 9 ft. high. These are to be precast in sections; that is, each one of the four sides with mitered corners, reinforced with corrugated bars and the concrete faced with a white cement mix.

The four pyramids are to be placed on top with a precast 1 ft. 6 in. square base, and 9 in. high. The floor of the mausoleum is to be of concrete, sloped to drain toward the entrance, upon which is laid 6-in. x 6-in. concrete floor tile. The arch over the entrance is designed for reinforced concrete cast in position (radius 12 ft.) and 8 in. thick. Strips of wood with beveled edges are to be inserted in the form to give the appearance of a keyed arch.



Figs. 1 and 2—Front and Side Elevations, Family Mausoleum

The cornice will be cast in place and a one-half inch asphalt-felt expansion joint left between it and the roof slab. The entrance opening is 10 ft. wide and the double iron gate is a standard design.



Figs. 3 and 4—Details and Foundation Plan of Asheville Mausoleum

Grandstand With Gunite Seat Deck

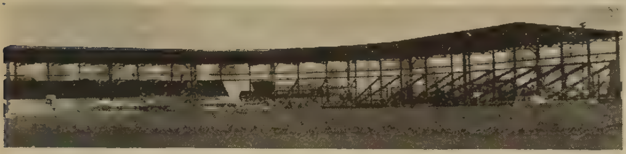


Fig. 1—General View of Stadium

The Nash Motor Co. of Kenosha, Wis., recently put into service a new grandstand on its baseball field which embodies some new and novel features. Chief among them is the use of gunite in place of concrete in a portion of the structure. The stand is of steel and gunite construction with a wooden roof. It is 37 ft. deep x 380 ft. long at the back and 304 ft. long at the front or on the playing field side, and has a seating capacity of 2500 people.

The seat deck, which is built of reinforced gunite, is supported on 20-in. I-beams spaced 16 ft. o. c. The treads are 2 ft. 10 in. wide and the risers 14 in. high. The reinforcing in the gunite consists of steel bars and wire mesh. The wire mesh used is a 4x4 welded fabric having No. 6 gauge wires in each direction. The risers and treads are 2 in. thick and there is a nosing at the front edge of each tread 2 in. wide projecting ¾ in. beyond the face of the riser, which adds greatly to the appearance of the structure.

Fig. 1 shows a general view of the stadium before it was completed. To the right of this picture is shown only the steel and roof erected. At the extreme left end is shown the gunite deck in place and near the center can be seen the forming ready for the shooting of gunite.

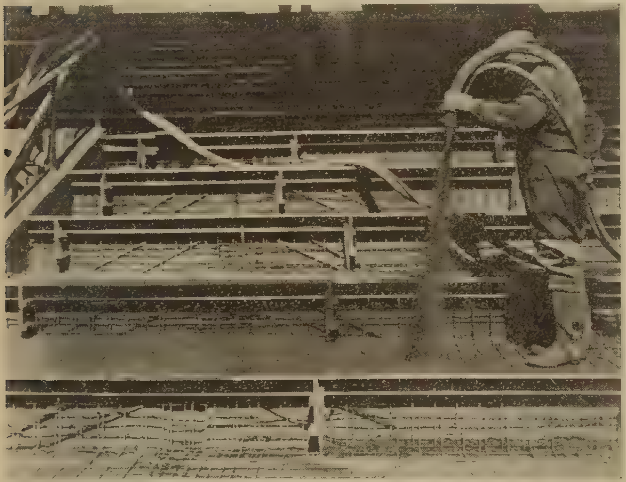


Fig. 2—Placing Gunite. Forms and Reinforcing in Place

Fig. 2 is a close-up view showing reinforcing and forms in place and a man placing gunite.

The gunite used on this job consisted of a 1:3 mix of portland cement and washed torpedo sand. The surface was left with a smooth float finish. After the forms were removed the underside of the seats and the back of the risers was given a thin coat of gunite as an extra protection against moisture penetration from the underside.

This gunite deck was designed and built by the Cement-Gun Construction Co. of Chicago. The work was started early in March but on account of the unusually severe weather it was not completed until about April 27th. Nearly all the gunite was placed during the last 10 days of this period, during which time two crews were used, running the cement-gun outfit 16 hrs. each day.

This job was secured in competition with a poured concrete deck slab, and the Cement-Gun Construction Co. of Chicago not only beat the poured concrete job in price, but also gave the owners a harder, denser and stronger concrete than could possibly have been made by the ordinary pouring methods.

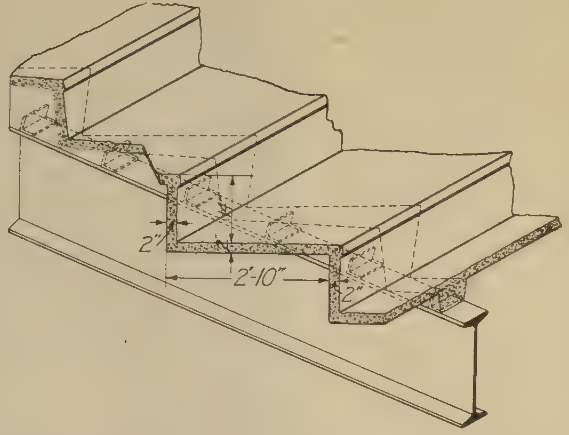


Fig. 3—Sketch Showing How Gunite Deck Rests on I-Beams with Anchors to Prevent Deck from Sliding on Beams

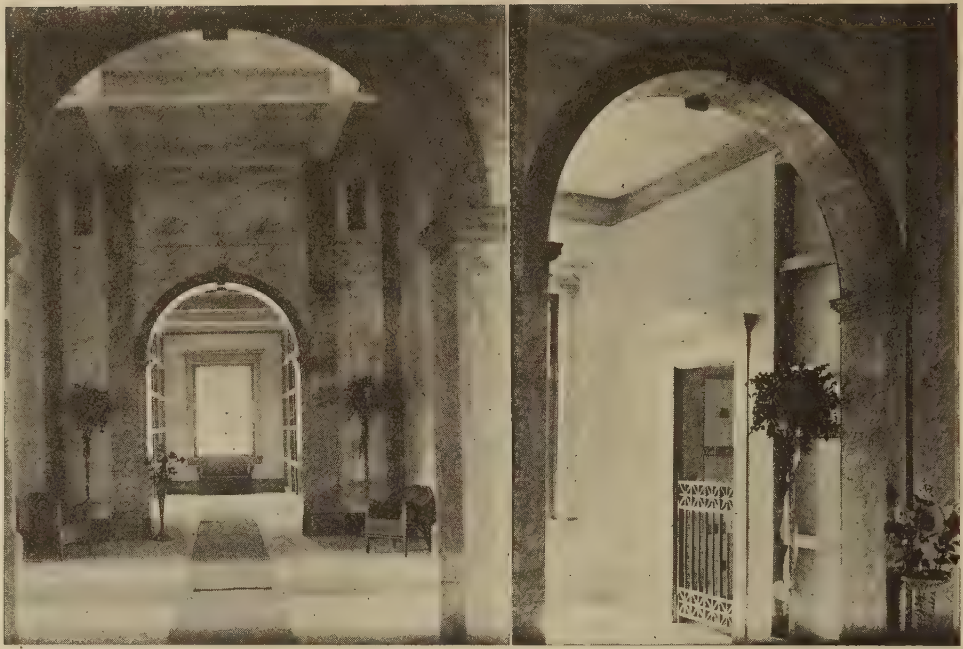
---

Two Sources of Profits in Products Business

The two sources of profit to the products man are the reduction of labor costs by efficient plant layout and the use of labor saving devices, and the reduction of overhead costs by increasing volume of production. Most of the leading plants pay particular attention to the first of these two, but the additional profit that can be gained by keeping the plant going every day of the year is only secured in those few plants that are headed by wise, farsighted business men. The products plant should not close down as soon as orders begin to fall off in the late fall as so many do.

It is true that in the winter periods block cannot be sold as fast as at midsummer, but to compensate for this there is the usual spring rush that calls for two or three times as many block per day as the plant can possibly produce, and where a large stock has not been piled up during the winter months, the products plant loses a lot of business that it might otherwise have secured and is also likely to jeopardize its reputation by shipping green block that are not hard enough to stand handling.—Leslie H. Allen, Portland Cement Association.

Will products manufacturers continue operations through winter? Please write CONCRETE about methods and results.



Figs. 1 and 2—Interior Views of Chapel

Glenwood Mausoleum of Permanent Construction

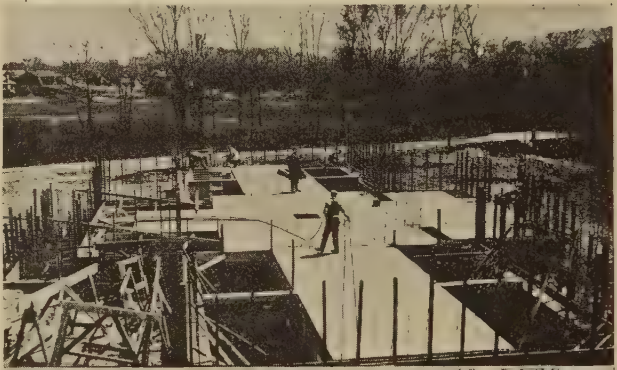
The newly completed Glenwood Mausoleum located in Glenwood cemetery near Waverly, N. Y., is of reinforced concrete with an exterior finish of Bedford cut stone and interior of Vermont marble. The building contains 220 crypts, 2 de luxe sections and 2 private rooms which are virtually family compartments or mausoleums within the community mausoleum.

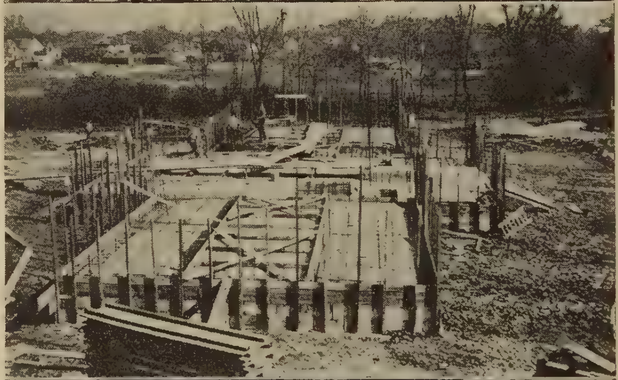
The crypts are arranged in tiers of 5-in. height and extend the full length of both corridors. Each crypt is 2 ft. 1 in. high, 2 ft. 6½ in. wide and 7 ft. 4 in. long, inside dimensions. The outside dimensions of the building are 46 ft. x 82 ft. The central portion is occupied by a chapel approximately 17 ft. x 25 ft. with corridors 9 ft. wide, giving access to the crypts. The openings into the corridors are crowned by semicircular arches, having a radius of 3 ft. 6 in. All corridor floors are finished with 10-in. x 20-in. white marble tile, ⅞ in. thick, with sand finish.

The ventilating system consists of 220 1¼-in. galvanized iron pipe, one pipe being for each crypt. These pipes are 18 ft. long and are placed inside the concrete walls to take in fresh air from the outside bronze ventilators which are covered with fine copper screen. They run above the ceiling into an attic between the ceiling and roof. Here the air from the pipes is mixed with fresh air and then let out through a ventilating tile in the roof. The vertical tiers of crypts are separated by 5½-in. walls except under the ceiling beams where the walls are 11½ in. thick.

Figs. 1 and 2 show interior views of the ceremonial chapel.

The basement space is enclosed by the main monolithic concrete walls, 1 ft. 11 in. thick up to the grade line. The walls rest on footings 4 ft. wide and 1 ft. thick. The basement, having a clear height of 7 ft. below the main floor, is divided into spaces for receiving





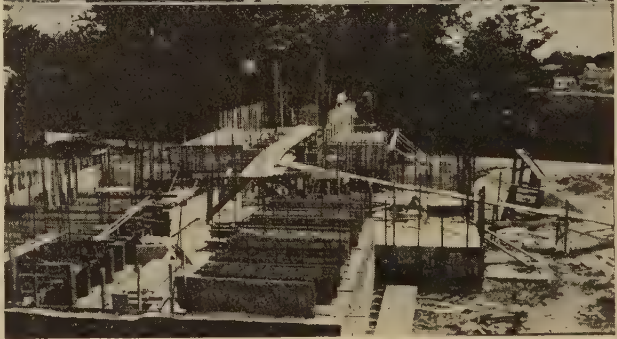


Fig. 7—Foundation Walls and First Sections of Floor Poured

Fig. 8—Forms and Reinforcing in Place for Floors Under Crypts

Fig. 9—Placing Forms for Bottom Row of Crypts

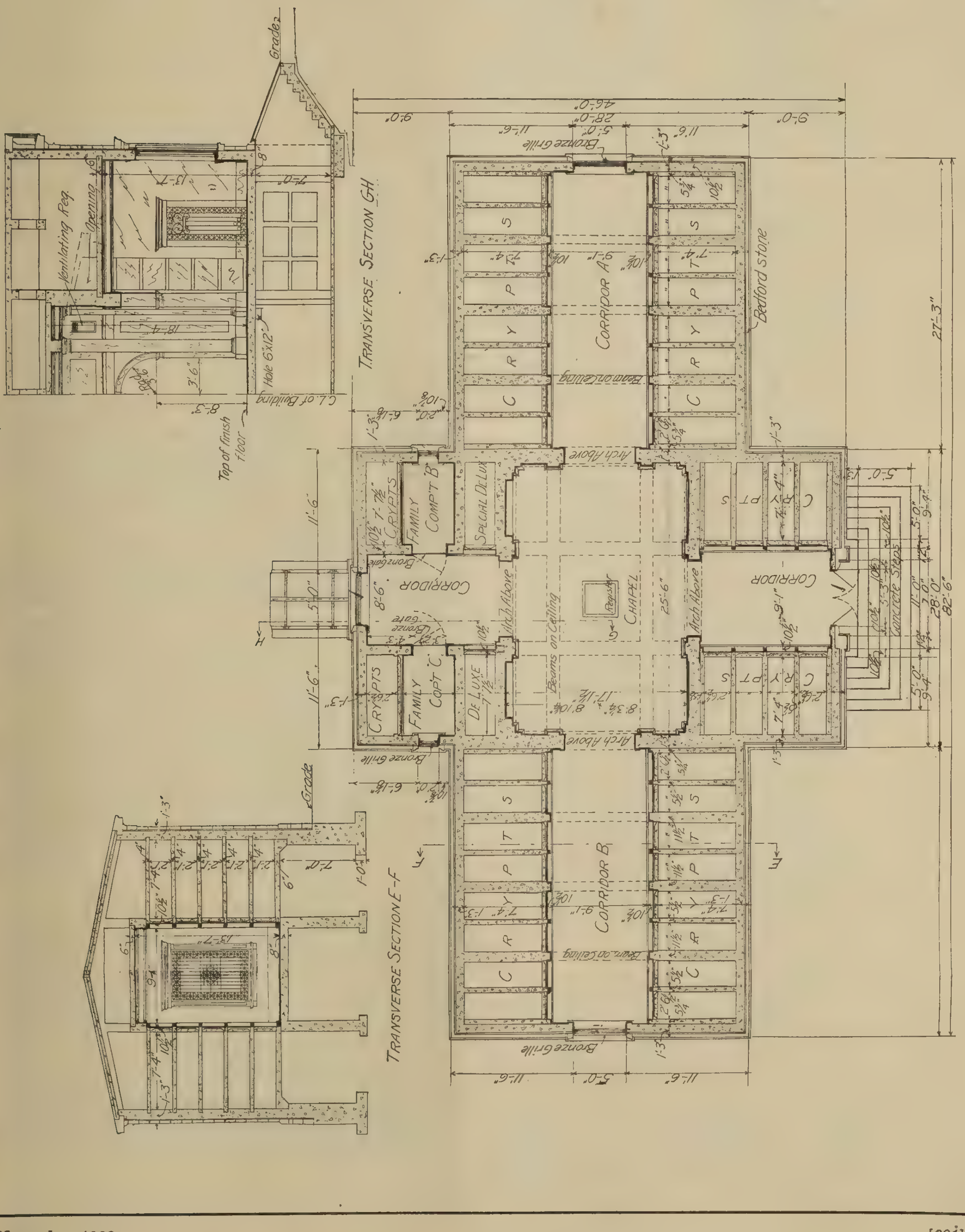


Fig. 3—Sections Showing Interior Arrangement

Fig. 4—First Floor Plan of Mausoleum

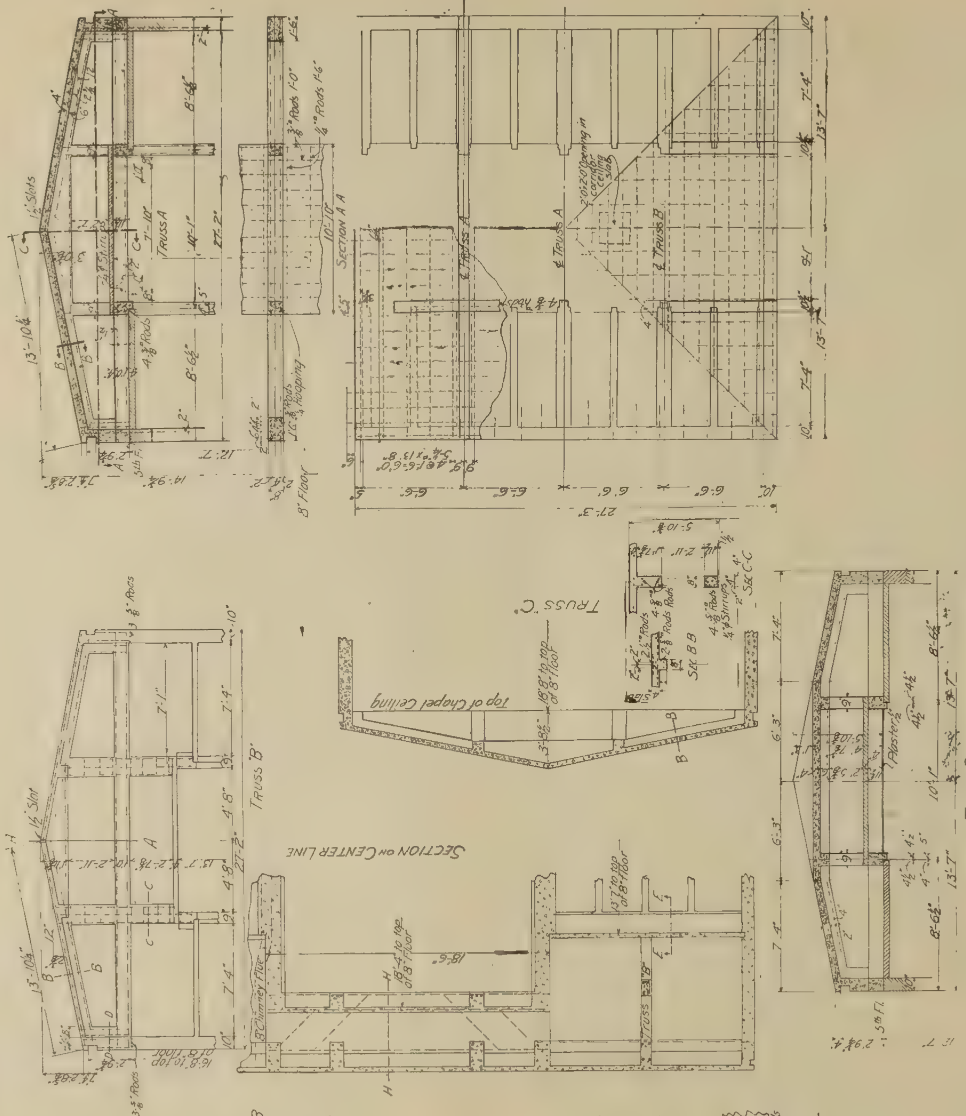


Fig. 6—Details of Roof Slab and Trusses

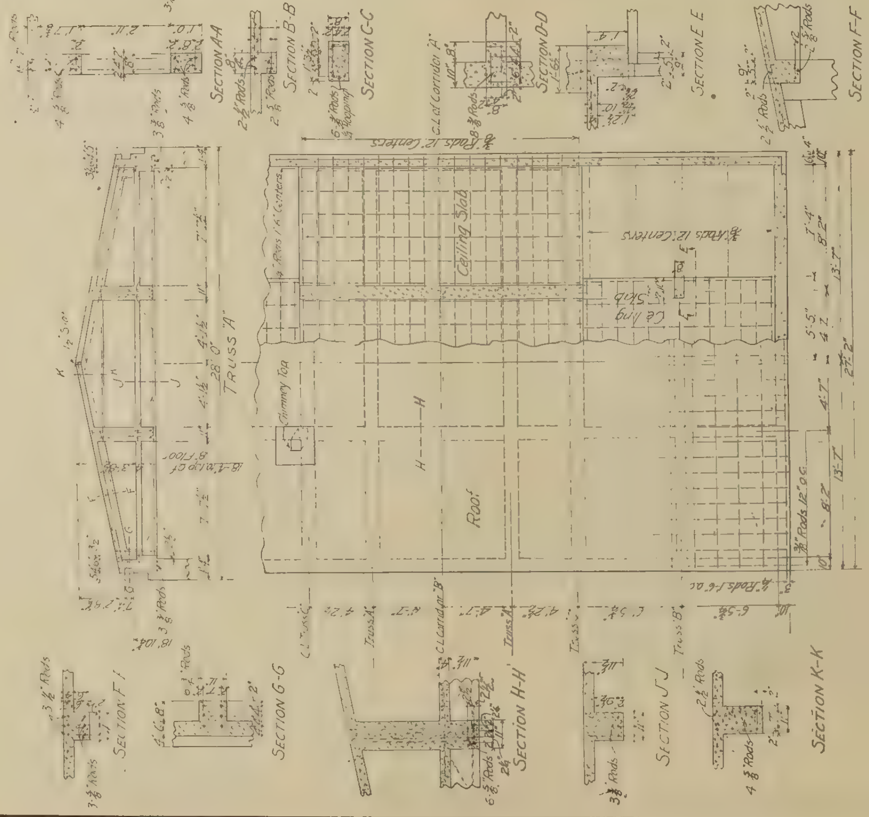


Fig. 5—Details of Ceiling

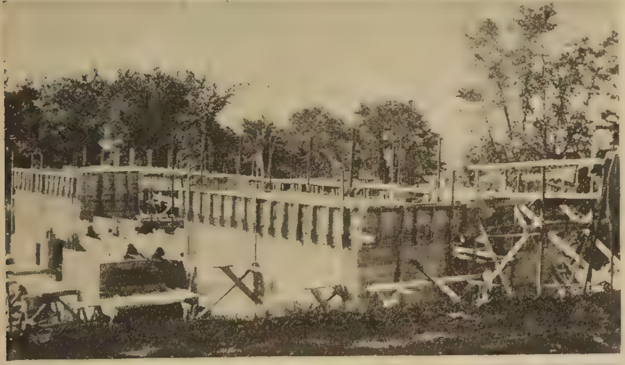
vaults, and also contains the heating plant for the chapel. The walls which form the compartments in the basement support the corridor and chapel floors and the floors under the crypts.

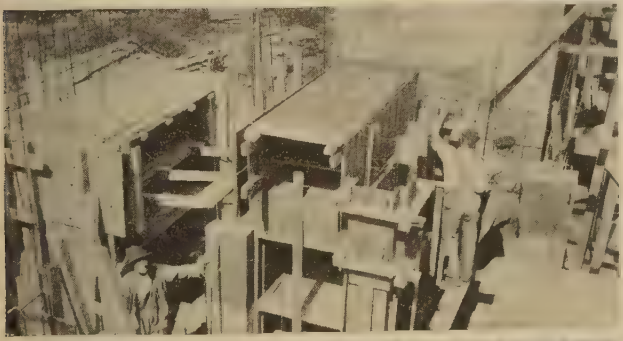
The height of the foundation walls above the basement floor is 7 ft. The basement floor rests on top of the main footings and is 5 ft. below grade except at the receiving vaults. The outside walls are reinforced with $\frac{3}{8}$-in. square vertical rods 12 in. o. c. and horizontal rods $\frac{1}{4}$-in. square 18 in. c. o.

The main floor system is divided into two parts. One section in the entrance, chapel and corridors, is an 8-in. reinforced concrete slab and the floor under the crypts is a 6-in. slab with reinforcing system similar to that used in the 8-in. floor section.

The top of the 8-in. floor slab is 3 ft. above the grade and the top of the finished floor, 2 in. higher. All rods in the 8-in. floors extend to within 2 in. of the edge except at exterior walls where they enter the walls 8 in. Alternate rods are bent up. The reinforcing consists of $\frac{1}{2}$-in. square rods placed 2 in. above the bottom of the slab and $\frac{1}{4}$-in. rods resting on top of the $\frac{1}{2}$-in. rods. The $\frac{1}{2}$-in. rods are spaced 6 in. o. c. and the $\frac{1}{4}$-in. rods 18 in. o. c.

The 6-in. floors under the crypts rest on the edge of the main floor, the lap being separated by a tar paper joint. This arrangement makes the bottom of the lower crypts 6 in. above the corridor floors.





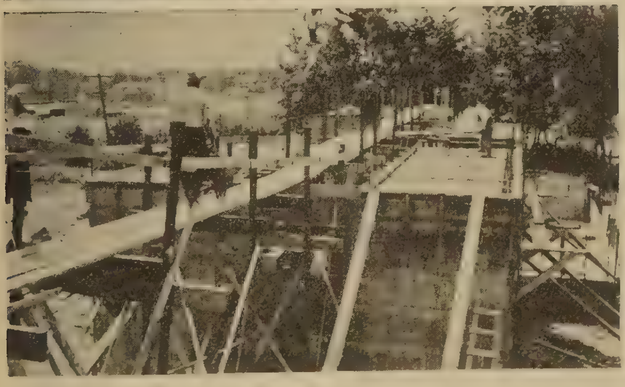


Fig. 10—Pouring Concrete from Plank Runway
Fig. 11—Placing Forms for Crypts
Fig. 12—Constructing Walls and Crypts Monolithically

Both the ceiling and roof slabs are 4 in. thick, reinforced with $\frac{3}{8}$-in. square twisted rods, 12 in. o. c. and $\frac{1}{4}$-in. rods 18 in. o. c. longitudinally. The ceiling slabs are supported by beams and the roof rests on reinforced concrete roof trusses, details of which are shown in the accompanying illustration.

In constructing the mausoleum, the exterior walls as well as the dividing walls in the basement were poured up to the elevation of the bottom of the corridor floor. Forms were then set up on top of the walls and the main floors poured, leaving openings under the crypts. After the main floors had hardened sufficiently, forms were set for the remaining floor sections and the remaining slabs poured.

The box-like forms for the crypts were built up of sections that could be easily removed. The crypt walls were poured monolithically with the exterior walls and $\frac{3}{16}$-in. copper wires were embedded in the concrete of the outer faces of the main walls for bonding the exterior finish of Bedford cut stone. Forms for the walls were constructed of 2-in. x 4-in. standards and ordinary sheathing, the forms being held in place by wire ties.

The main wall reinforcing consists of $\frac{3}{8}$-in. square vertical rods 12 in. o. c. and $\frac{1}{4}$-in. horizontal rods 18 in. o. c.

Concrete was wheeled from the mixer in wheel barrows and distributed on the job as fast as the forms were erected and the reinforcing placed.

The mausoleum was designed and built by the Claude W. Smith Mausoleum Co., Elmira, N. Y.

A Sand "Library"

In Chicago is a "library" made up of sand—just bottles of sand. There are 2,800 of these bottles and they form part of the Structural Materials Library of the Lewis Institute.

This "sand library" was started ten years ago and is said to contain specimens of sand from every state in the union and from many foreign countries.

Why such a collection?

To help put building on a more scientific basis. Each of the samples has been carefully tested, and a record made of each. These records include the source of the specimen, the grading, silt content, and the results of the colorimetric test for organic impurities. In most instances mortar and concrete tests also have been made. These tests were made to ascertain the suitability of the various sands for concrete and mortar work.

This is probably the only collection of its kind in existence, and the information contained on the labels of the bottles gives an interesting insight into the part science is playing in modern industrial undertakings.—*Business Chemistry*.

If you have tried out an idea, and it "worked" on your job, pass it along to "the other fellow"—through this magazine.

Graded Aggregate:

News, Review, Hearsay, Comment—A Department of Fragmentary Miscellanies—the material for which will be gathered from the job, the office, the factory, over the lunch table, in Pullman smokers, from the morning mail and many other sources.

The Next Building Season

Conditions affecting construction activities next spring will be closely similar in character to those which prevailed at the opening of the eccentric building season of 1923, according to indications drawn from statements of leading general contractors and other observers of the trend of operations, to the *Constructor*, the publication of the Associated General Contractors of America.

The belief in some quarters also seems to be that an unusual amount of work is to be undertaken for completion during the first months of 1924. In some sections of the country, where the deficiency in buildings is especially noted, leaders are advocating that winter construction be urged, with a softening of prices of materials and of wages being held as inducement for this step to be taken to avert an extraordinary demand during the months when construction ordinarily is placed under way.

* * *

Reinforced Concrete in Sea Water

Two inches of good concrete will protect reinforcing from sea water attack, according to a progress report of a Committee of the Institution of Civil Engineers which is reviewed in *Engineering*, London. The report covers "Deterioration of Structures of Timber, Metal and Concrete Exposed to the Action of Sea Water." This is the Third Interim Report. The findings as to reinforced concrete are summarized as follows:

> In 1917 a number of slabs of reinforced concrete were exposed in the Brisbane river at a point where the water was practically as salt as sea water, the blocks varying in the extent to which the reinforcement was covered, and to some extent in the composition of the concrete. From a note by E. A. Cullen, engineer to the Harbors and Rivers Department at Brisbane, it appears that although less additional rusting than had been expected has occurred since the last examination eighteen months ago, nothing less than 2-in. covering is sufficient, so far as these observations go, to give complete protection. In the blocks with thinner coverings little difference has been found in the deterioration between 2 sand-1 cement concrete and 4 sand-3 cement. In a reinforced concrete wharf on the Brisbane river completed by Mr. Cullen in March, 1917, the piles and girders have a 2-in. covering over the reinforcement, and the whole structure was well tarred with hot distilled tar on all surfaces except the deck, the tar being carried down the piles to about the level of mean neap high water, and the tarring being repeated a year later. Below mean sea level the piles are encrusted with small barnacles, but on recent examination, five and a half years after completion, no corrosion had occurred.

* * *

WHEN A NEW TOP IS TO BE PLACED ON AN OLD CONCRETE SLAB, the surface of the concrete slab should always be thoroughly roughened with picks or chisels before the new top coat is placed. After the new top coat has been finished and allowed to harden sufficiently, it should be protected by flooding it with water or covering with damp sand for at least five days. This prevents the floor from drying out too rapidly. Floors which are not protected from drying out too rapidly frequently develop cracks.

Building Labor Outlook for 1924

"It is perhaps too soon to begin a survey of probable conditions in the labor market for next year," says the National Association of Building Trades Employers, "but judging from data gathered, 1924 will not be much different from this year so far as the shortage of mechanics in the building industry is concerned. It is expected that the volume of construction for 1923 will exceed that of any previous year, and from every indication 1924 will equal if not surpass the high mark set this year. Elimination of seasonal unemployment has gained considerable headway; there is but little unemployment in the building trades taking the country as a whole, and judging from the number of large projects which will be carried over into the winter months, labor will be steadily employed through a season during which formerly there was but little work. Except in isolated cases there have been no wage increases granted to the building trades for two or three months, and many cities report that the bonuses which were paid earlier in the season are no longer necessary. It is generally believed that the building trades will not make a fight for higher wages when present agreements expire, but will endeavor to have existing contracts extended for another year."

* * *

Power

It has recently been argued and with some show of logic that man's laziness is at the root of all his enterprises—that the modern methods of production, the tremendous celerity of industrial processes have their inception in the desire to find easier ways of doing things. Just how much the world is in debt to its lazy men is a theme for polite debate. We should be a little on the side of the idea that our progress is not so much to the credit of the man who is trying to avoid work as to the one who is not content with the powers given him in two hands and two feet and a back for burdens. Such equipment has well defined limits of performance and even when human beings were cheaper than now, the idea was much pondered; how to multiply, through mechanical devices, the human powers to perform. From many sources F. L. Morse of the Morse Chain Co. has assembled a brief review of "Power: It's Application from the 17th Dynasty to the 20th Century." This was presented as an address at the 26th annual convention of the American Mining Congress and is now done into a pamphlet of 46, 6x9 pages, carrying many curious and interesting illustrations. In it is traced the history of devices to multiply or to supplement human strength.

* * *

THE PROSPECTIVE WINTER OPERATOR OF A PRODUCTS PLANT CONFRONTS THE DIFFICULTY OF HANDLING AGGREGATES IN COLD WEATHER. Gravel banks freeze and cannot be worked, and stock piles and outdoor bins are equally difficult to work. It is, however, a simple matter to turn steam pipes into bins and thus at small expense keep them free from frost. It does not require a great amount of heat to do this. Good storage bins are therefore essential to winter operation. The products plant should be equipped with good-sized bins for winter storage of raw material. One plant in the suburbs of Chicago has just built a large silo 24 feet in diameter and 60 feet high in order to safeguard its winter operations. This is now being filled with aggregate for winter use.

* * *

Cement Association Man Sails For Japan

Homer M. Hadley, district engineer in charge of the Portland Cement Association office at Seattle, sailed for Japan October 5 to make a thorough investigation of how modern structures, particularly those consisting largely of reinforced concrete, withstood the recent earthquake. Mr. Hadley is particularly well qualified for a mission of this kind, having for many years specialized in structural engineering. Before joining the forces of the Portland Cement Association, his practical experience included a number of years with some of the foremost engineering firms on the Pacific coast. Shortly before coming with the Portland Cement Association, Mr. Hadley was structural engineer for the Seattle School District.

Mr. Hadley's trip will probably require three months or more absence from his official duties with the Portland Cement Association.

* * *

The Chemist Comes Into His Own

The chemist is now vocal. He is getting himself on record. Chemists and engineers have until very recent years been exceptionally bad advertisers. The public's knowledge of their prowess was hazy. They were assumed to be necessary evils in some contingencies. Their potential powers in relation to dividends were in many cases destined to remain potential and have no relation to dividends. And then—for instance from the very interesting house organ *Business Chemistry*, of Skinner, Sherman & Esselen, Inc., Boston:

> Some years ago copper refiners operating in certain parts of the country were using an ore which gave off objectionable fumes of sulfur dioxide while being converted into metal. As soon as one of these refineries was in operation the people living for miles around protested against these fumes, to which they attributed all sorts of harmful effects, some of which at least could justly be attributed to them.
>
> The copper refiners were in a critical position: either they had to shut down their plants, or else find some way to avoid the obnoxious fumes.
>
> A chemist was called in and he showed them how to collect the objectionable fumes and convert them into sulfuric acid, which is the basic acid of all chemical industry. Thus by the aid of chemistry a nuisance was turned into a valuable by-product; dividends were extracted from fumes!
>
> Another story is told of a copper refinery from which a small brook ran. Into this brook the refinery had been in the habit of running certain wastes which carried enough copper to give the brook a green color, but which they always considered of no value.
>
> Shortly after leaving the refinery, the brook ran through the yard of an Irishman, and one day he appeared at the office of the company and inquired whether they would object to his damming up the brook where it ran through his yard so that he might make a little pond where he could keep his ducks. There was no objection to this on the part of the company and the man proceeded to purchase his ducks.
>
> Some weeks later a man called on the copper refiners and asked them who their new local competitor was. So far as they knew they had no competitor in town, but upon looking into the matter they found that it was the practice of the Irishman to fill his pond at night with all sorts of tin cans and pieces of scrap iron. On these the copper which was contained in the water was precipitated. This he recovered and converted into salable form. He was their new competitor.
>
> Nowadays the same principle which this man used in a crude way is quite frequently employed in recovering copper.

A JOINT MEETING OF THE ASSOCIATED GENERAL CONTRACTORS AND THE AMERICAN ROAD BUILDERS' ASSOCIATION will be held Thursday, Jan. 17, 1924, in Chicago, to discuss various matters of importance to the membership of both organizations. This joint meeting has been made possible by the proximity in dates and places of the organizations' annual meetings. The 1924 convention of the American Road Builders' Association will be held Tuesday, Jan. 15, to Friday, Jan. 18, inclusive; while the Associated General Contractors meet the following Monday, Tuesday and Wednesday. All the officers, the executive committee and the heads of the twenty-eight chapters of the Associated General Contractors will, however, be in Chicago the previous week. Many of the members of the organization also will be in Chicago that week attending the convention and road show of the American Road Builders' Association.

* * *

House Withstood Earthquake

Japan's recent catastrophe prompts publishing a letter reminiscent of an experience in Jamaica, B. W. I., in 1907. Some time previous, the Aberthaw company built a large reinforced concrete residence, "The Folly," at Port Antonio for Alfred Mitchell. The letter from the owner and occupant of the house was written to the builders shortly after a severe earthquake on the island. The letter follows:

> THE FOLLY, PORT ANTONIO, B. W. I.
> January 21, 1907.
>
> I write to you to let you know that the house at Folly and all the other concrete erections upon the place have passed through the late earthquake without showing the least crack or shake. From the accounts you get in the papers, which are all derived from sources desirous of minimizing the violence of the shock upon the north side of the island, you will get a very false idea of it. Perhaps the relation of the following fact will enable you to appreciate the degree of movement to which we were subjected.
>
> Owing to mis-judgment of proper time of repairs, when we arrived here we found very little water in our reservoir, which was soon consumed. An unparalleled drought followed, and we have had not a drop of fresh water since about the first of January. Consequently, we have used our bath tubs all over the house as tanks for salt water for use in flushing the water-closets. At the time of the earthquake all bath tubs put to such use were about half full of sea water. In every case a considerable part of the water was splashed over the sides or ends of the bath tubs upon the floor of the bath rooms, where it was swabbed up by our servants after the shock. The rumbling noise, which momentarily preceded the first and heaviest shock and which seemed like the passage of a train of cars over the roof, drove us out of doors, and it seemed as though the house must be shaken to pieces. But we soon returned to it to ascertain what damage had been done, and found only the bath room floors flooded as I have stated.
>
> I give you this information because it is a great satisfaction to us to feel so much security in the strength and solidity of our house, a satisfaction which you, as its builder, must certainly share. I wish you would send this letter for his information, to Mr. Frazer who will be equally interested in its contents, and I may add that you are at liberty to make such use of it as you may see fit in the furtherance of your business interests.
>
> Very truly yours,
> ALFRED MITCHELL.

* * *

Products Plant Overhead

The overhead expense of a concrete block plant is going on whether the plant is busy or idle. A plant that operates for nine months and produces 200,000 block sold at 20 c. does a total business of $40,000 a year. This can be divided roughly into $20,000 for materials, payroll, etc., $10,000 for overhead expense and $10,000 for profit. If this same plant operates the full twelve months at the same rate it will produce 267,000 block, with a turnover of $53,000. Ignoring for the moment the savings that come from better labor conditions and lower material prices in winter, let us figure pro rata that labor and material will cost $26,700. The overhead will increase very slightly. $1500 will easily cover any additional expense under this head, including interest on bank loans, making the total overhead for the year $11,500. So that the total year's profit will be $15,200 instead of $10,000.

Example:

	200,000 block 9 months' operation Selling price 20 cents	267,000 block 12 months' operation Selling price 20 cents
Labor and material	$20,000	$26,700
Overhead	10,000	11,500
Profit	10,000	15,200
Gross Sales	$40,000	$53,400

* * *

Industry Needs Technically Trained

American big business is confronted by the little-understood necessity of filling, by 1930, at least 200,000 new positions of responsibility in industry, whereas there are available in the technical schools at present only about 50,000 students. Enrollment in these schools in 1920, when the first of the graduates aiming to be the future leaders in industry took up study, was 51,908, and today the enrollment is only 52,290. There aren't enough technically trained leaders. A committee of business and educational leaders has been organized by the National Industrial Conference Board into a joint conference committee on engineering education, and it includes men distinguished in the fields of education and industry. The first autumn session has just concluded preliminary conferences at the headquarters of the National Industrial Conference Board at 10 East Thirty-ninth Street, New York.

* * *

The Cleveland Builders Supply & Brick Co., said to be the biggest building supply dealer organization in the world, and in the heart of a clay products region, has gone in for concrete building unit manufacture. This is interesting as indicating the fact that such an organization finds it of advantage to produce concrete building units along with clay units of which it is also a big producer. C. E. Ehle is managing the concrete products department which operates two 24-in. and two 16-in. anchor stripper block machines and one Hobbs machine, two Kent, one Blystone and one Jaeger mixers, and three Walter Concretile machines.

* * *

Sprays His Product

One of the most unique exhibits at a recent industrial show, says the *Queens County News*, was that staged by John J. Bliss, manufacturer of Bliss blocks, Jamaica, N. Y., who, in order to demonstrate the impervious nature of his brand of cement blocks, constructed a small house. In the center of this he installed a fountain from which water constantly played upon the walls, and in this novel fashion proved his claims, because after days and nights of this watering the blocks were still bone dry on the outside.

* * *

The Annual Convention of the American Concrete Pipe Association will be held in Chicago, January 17, 18 and 19, at the Sherman Hotel—the week of the Annual Roads Show.

* * *

"Making Concrete and Cement Products in Winter" is the title of an 8-page illustrated bulletin of the Portland Cement Association, which tells what precautions to use in making concrete work a year-round activity.

Cement Manufacturers Protective Association Dissolved by Judge Knox

Judge Knox, sitting in the United States District Court for the Southern District of New York, handed down an opinion, on October 23, 1923, holding that the Government was entitled to an injunction dissolving the Cement Manufacturers Protective Association.

The opinion of the District Court finds that the association was formed for the exchange of information concerning credits, specific job contracts, freight rates, and statistics of production, stocks and shipments. It finds that there was no agreement as to prices; that the price of cement had advanced less than prices of other basic commodities; that the activities of the association had not destroyed competition between the manufacturers, but the exchange of statistics tended to make competition between them more feeble, and the association should therefore be discontinued.

It is understood that the case will be taken to the Supreme Court of the United States.

On August 8, 1921, a Federal grand jury filed indictments against the 19 Eastern cement companies which made up the Cement Manufacturers Protective Association, and 44 individuals who were officials and agents of these different companies. The defendants named in the indictments were tried in 1922 on a criminal charge of violating the Sherman anti-trust law, and the jury, sitting in the Federal court for the Southern District of New York before Judge Knox, disagreed. This case was reported for Concrete by Edwin C. Eckel, beginning in the May, 1922, issue.

The Government apparently dropped the criminal case after the jury disagreement, but took up, instead, the equity suit just decided. The mass of evidence produced at the trial of the criminal case was used in pressing the equity suit, filed in June, 1921, for the dissolution of the Manufacturers Protective Association.

The Cement Manufacturers Protective Association, which was created in 1916, is in no way connected with the Portland Cement Association. The 19 companies that were members of that association also were members of the Portland Cement Association, but not all members of the Portland Cement Association having plants in the eastern part of the United States were members of the Cement Manufacturers Protective Association.

A former member of the Cement Manufacturers Protective Association writes Concrete as follows: "The injunction granted by Judge Knox against the Cement Manufacturers Protective Association is of little practical importance in view of the fact that the Protective Association was disbanded voluntarily by its members more than two years ago. * * * The voluntary dissolution of the Protective Association was thought wise in view of the Government's questioning its activities, and the cement manufacturers did not want to appear to defy the Government. It was thought best to disband the association until the matter should be finally settled."

A 2 h.p. size has been added to the Hercules line of gasoline engines (The Hercules Corp., Evansville, Ind.) to fill a gap between the 1½ h.p. and the 3 h.p.

Two Decades of Concrete Progress

There are always at least two reasons for attending a convention of the American Concrete Institute—one, to find out what are the latest and best ideas as to quality and economy in doing any kind of work with concrete; the other to renew acquaintances and foster that personal fellowship which binds together those men who are bent on the solution of common problems.

A recent Institute *News Letter* points out a third reason for going to the 1924 convention—the third one: because the special Anniversary plans will enable us to see our field in the broad perspective of two very busy decades. Small individual problems melt into the major tendencies of the industry. At the 20th annual convention there is to be visualized for us the panorama of 20 years, so that we may see where we have come from and by what route, in all our departments of concrete work, and have a look too into the future, the road ahead of us, and future more desirable destinations. The *News Letter* continues:

One day of the Convention will be given to the Anniversary celebration—brief reviews of chapters in the history of concrete and reinforced concrete by men who know it best (most of that history lying within the two decades of American Concrete Institute activities) together with a survey of the future possibilities of the material. This will be taken up in logical order following an outline somewhat like this:

Richard L. Humphrey, who was the first president of the organization, when it was formed in 1905 (then the National Association of Cement Users) and who continued as president for the first decade of the Institute's organization, will deliver a short introductory address, sketching the circumstances which led to the foundation of the Institute, mentioning some of the men who were outstanding figures at that time, the principal uses of concrete, their relative importance then, and the extension of its uses and their importance now. He will tell how the advantages of this plastic material gradually exerted their economic power, and how concrete came gradually to be accepted by the engineering profession. He will then introduce those who will speak on special phases of this development.

Frederick W. Kelly, president of the Portland Cement Association and of the Helderberg Cement Co., will take up the subject of *Cement* and its development as the basic essential in concrete. Mr. Humphrey will then outline the subject of mass concrete, and sketch the development of the application of the material, introducing a speaker who will take up the subject of *Dams, Tunnels, Conduits* and *Culverts.* A. N. Johnson will consider *Roads*, a subject that has been given greater study than any other in the concrete field.

Opening the afternoon sessions of the Anniversary day, Mr. Humphrey will introduce the subject of *Reinforced Concrete*, Albert Kahn, architect, presenting an address covering a building review of the last twenty years, and touching on the possibilities of lighter, more elastic concrete structures in the future, and the greater economy to be brought about by greater knowledge, better materials, and more perfect control.

A. E. Lindau will discuss how reinforced concrete permitted culverts to be developed into *Bridges*—the possibilities of lace-like structures in the future. M. M Upson will consider concrete *Piles* and *Water Front Work.* A speaker will be assigned to the subject of *Concrete Products*, a very broad field, the growth of which in the last few years has been very remarkable.

Consideration of the development of the mechanics of *Handling Concrete* will also be assigned to an authority, who will discuss the gradual improvement in the tools with which the industry works. John J. Earley will handle the subject of *Architectural Concrete*, including cast stone and architectural concrete cast in place; basic architectural requirements and how they may be met with concrete; the greater freedom of design which is to be expected when the material is under more perfect control.

A. N. Talbot will consider the influence of *Engineering Research* in the development and use of concrete and reinforced concrete. Duff A. Abrams will present the subject of *Laboratory Research*—how the laboratories are enabling us to take greater advantage of this plastic material. This will be followed by Mr. Humphrey's closing remarks, in which he will sketch the promise of the future, in which disconnected truths will be ordered in a general law and the usefulness of concrete is limited only by our ability properly to apply it.

In the evening of the same day, there will be a banquet, Robert W. Lesley, toastmaster. Charles R. Gow will present anecdotes chiefly of the early days of the acceptance and development of concrete. There will also be brief addresses by John R. Morron, president Atlas Portland Cement Co., and it is anticipated that the committee will arrange also for an address by Prince Caetani, Italian Ambassador to the United States.

This special Anniversary program will be illustrated, so to speak, by means of an exhibit which will be arranged by John J. Earley in charge of a sub-committee of the 20th Anniversary Committee. The exhibit will be in groups following the outline given in the historical addresses, and will consist of models and pictures of buildings and other structures, drawings, and photographs and samples of concrete and concrete objects. The 20th Anniversary Committee in charge of this special part of the program is as follows: E. D. Boyer, New York; L. C. Wason, Boston, Mass.; B. F. Affleck, Chicago, Ill.; John G. Ahlers, New York; Arthur Bent, Los Angeles, Cal.; H. J. Brunnier, San Francisco, Cal.; T. L. Condron, Chicago, Ill.; John J. Earley, Washington, D. C.; W. P. Anderson, Cincinnati, Ohio; Charles R. Gow, Boston, Mass.; Richard Hardy, Chattanooga, Tenn.; W. K. Hatt, Washington, D. C.; S. C. Hollister, Philadelphia, Pa.; Richard L. Humphrey, Philadelphia, Pa.; F. W. Kelley, Albany, N. Y.; William M. Kinney, Chicago, Ill.; Robert W. Lesley, Philadelphia, Pa.; Prof. A. N. Talbot, Urbana, Ill.; A. C. Tozzer, Boston, Mass.; M. M. Upson, New York; A. E. Lindau, Buffalo, N. Y.; Harvey Whipple, Detroit, Mich.; Frank C. Wight, New York; J. P. H. Perry, New York, Vice-Chairman; H. C. Turner, New York, Chairman.

EXHIBIT SUGGESTIONS

Suggestions are invited from members of the Institute who can direct the attention of the 20th Anniversary Committee to especially worth-while material for the Convention exhibit, which is being arranged by Mr. Earley. Models of machinery and systems of construction, models of buildings, samples of concrete of noteworthy interest, and attractive drawings and photographs are wanted—everything that will fit into the scheme of presenting the story of the development of concrete in the last twenty years.

REGULAR SESSIONS

Aside from the review, the regular Convention sessions will have notable features, from the standpoint of the various groups of membership interest. Special efforts are being made to bring about thorough and timely discussion of the most practical subjects in the concrete field. There will be a session for *Construction Superintendents* with special emphasis upon the importance of developing ideas direct from the job uninfluenced by theory as opposed to practice.

Questions and answers. Send your question in early so that it may be assigned and an intelligent discussion arranged for.

Three sessions on *Products manufacture.* The pressing necessity of bigger production, and the importance of obtaining quality while production is assured will develop *how to do it* discussion.

Practical production problems.
The roof tile color problem.
Modern curing methods.
Economical plant layout and *material handling.*
The results of *fire tests of concrete building units.*

A reconsideration of the tentative standards for *brick, block* and *tile* presented at the last Convention, which are the subject of criticism pro and con.

The whys and wherefores of *concrete failures.*
The use of *waterproofings* in concrete.
Practical problems in the everyday construction of *Sidewalks.*
The treatment of *Concrete Surfaces* for building interiors.
Practice in *Estimating* concrete.
Fine finishes for concrete *Floors* suitable for dwellings.
The selection of *Aggregates* for concrete.
New practice in concrete *Road construction.*
Standards for concrete *House construction.*

New French System of Concrete Sheet Piling

By Major Johnstone-Taylor

A new system of sheet piling known as the Ravier is of interest in view of the fact that the piles, in place of being of uniform section throughout, are for the greater portion of wide T-section.

The result is that for a given resistance to bending much less material is required. The general form of the pile is shown in Figs. 1 and 2. The bottom portion marked *a* is a rectangle. This portion is 5 ft. 3 in. long and has a sectional area of 10 in. x 6¾ in. The width of portion *b* is 5 ft. 7 in., the two wings being 3½ in. thick and the length 28 ft. The top portion *c* constituting the driving head measures 13¾ in. x 6⅞ in. It is not intended that the enlarged portion of the pile shall be driven far into the ground.

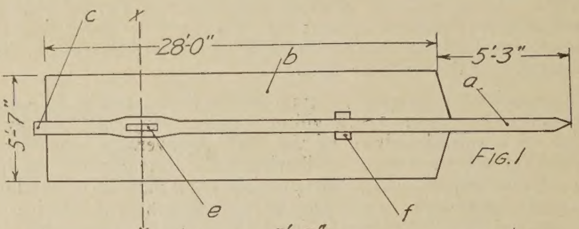


Fig. 1

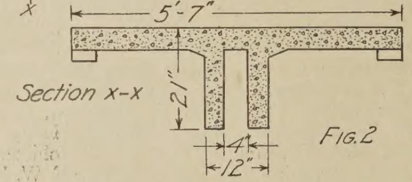


Fig. 2

Attention is drawn to the portion *e* of the pile, a cross section of which is shown in Fig. 2 and further details in Fig. 4. The object of the slot, which is 4 in. wide, is to take the head of a strut as shown in Fig. 3, holes 10¼ in. in diameter being formed for the purpose of receiving a pin. This arrangement refers to the upper strut *a* in Fig. 3. The lower strut *b* is differently arranged. By reference to Fig. 1 it will be seen that at point *f*, trunnions approximately 10 in. in diameter are formed on each side of the web projecting some 5½ in. Struts *b* (Fig. 3) therefore are in duplicate.

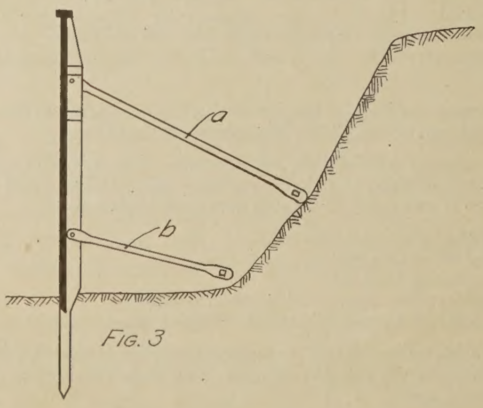


Fig. 3

At the lower ends these struts have rectangular holes for the reception of reinforced concrete anchor plates. Details of the struts are given in Fig. 5.

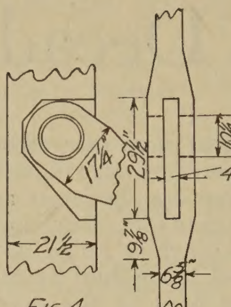


Fig. 4

Driving

In driving these piles the lower struts are jointed to the piles before the driving is complete, and they are at first suspended by means of a cable running through a block attached to the pile driving frame. The strut is allowed to fall with the pile as the latter is driven to its final position; then when the driving is finished the strut is lowered gradually until the anchor plate rests freely on the ground. By making or excavating the ground, therefore, the anchor plate can be made to take up a suitable position.

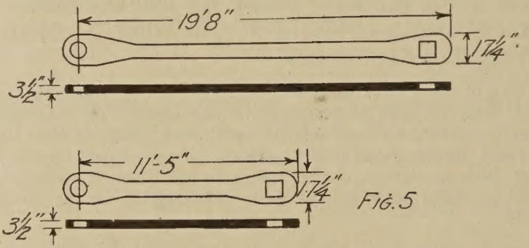
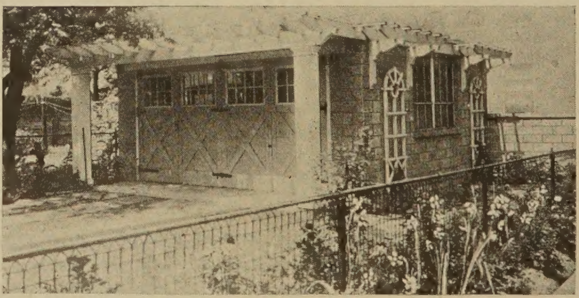


Fig. 5

With all the struts in position the space at the back is filled in so as to give extra support against water pressure and secure hold to the anchor plates.

A Concrete Block Garage



The picture is from a small photograph which the C. E. Lindsley Co., Inc., Irvington, N. J., mounted on an attractively printed folder calling attention to the use of high-grade faced block.

Sound Financing for Products Industry

It is a significant fact that in a recent study of failures of concrete product plants, more than half of the bankruptcies were found to be due to lack of adequate finance.

In one case after another the old story is repeated. An honest and industrious individual projects a concrete block plant in a flourishing little city with a good market assured in advance. He raises $6,000 to equip a plant. Ambitious machinery salesmen visit him and furnish good advice, and finally sell him $10,000 worth of equipment to go into a leased building which is remodelled at a cost of $1,500. Short time notes are given for $7,000 and the small amount of original cash remaining is quickly absorbed in payroll, overhead, materials and supplies, and then the little business with bright prospects and no cash goes under the hammer, a total loss to the owner.

What items did he leave out of his financial plan which should have gone in? Why wouldn't a local bank help the owner avert the crash? Are catastrophies of this kind just "bound" to happen, or can they be circumvented, and if so, how? These are all reasonable and important questions under the circumstances, for scores of ventures have gone the same route, some organized with small amounts of capital and others with amounts ranging as high as $200,000.

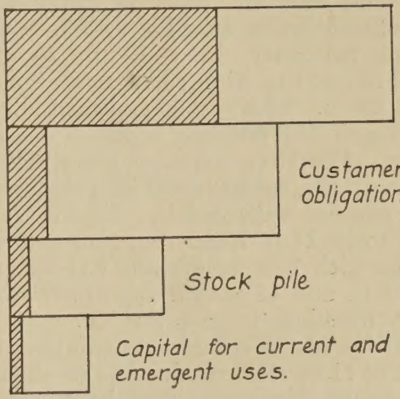
The fundamental difficulty seems to be that these ventures which failed through financial trouble have really succumbed to lack of good financial balance. The amount of capital must not only be adequate with respect to the market to be served, but it must be carefully apportioned among the many and varied items to be financed. If the would-be borrower has a good reputation or reasonable credit and the budget for his business has been carefully balanced, banks usually will extend reasonable loans; no one perceives more quickly than a banker the lack of financial "poise". In such a case few can freeze up as quickly as the banker, and refuse assistance as coldly. Remember, the banker is not paid for assuming any of his customer's business chances.

To begin with, over and above all allowances for material and current expenses such as payrolls, overhead and miscellaneous items, the concrete block manufacturer must figure on financing *at least* a month's run of block in his stock yard. In a plant manufacturing 1,000 blocks per day, this item should run from $2,500 to $4,000. And there is no way to reduce it except to carry an inadequate stock with a constant temptation to move block too soon, with a consequent excessive breakage. Many a lucrative job has been lost for the lack of just such a stock pile.

The next important item usually overlooked is provision for extending credit to customers. If a concrete block plant is competing with a brick plant and the latter will extend Mr. Builder 60 days' time, while the former must have its money promptly, Mr. Builder does business with the brick plant, unless the block manufacturer cuts his price precipitately, or in some other way counteracts the credit preference for his competitor.

In retail building material industries it is a very common occurrence to extend a builder or other customer from 60 days' to 90 days' credit. In every case the concrete products manufacturer has to follow credit practice in his community, or do business at a price disadvantage wherever his products are in competition. Then, in a plant manufacturing and selling 1,000 block per day, from $8,000 to $12,000 more might be required to carry credits, hauling, etc., with only a modest proportion of this to be cancelled off by reason of credit extended to the products manufacturer on his materials and supplies. A very large proportion of concrete products costs is in labor and overhead items which cannot be extended.

The most valuable asset any manufacturer can have, in a financial way, is to become known as a good moral risk. Sufficient capital should be on hand to discount all bills. The account should never be overdrawn, but, on the other hand, an ample balance kept to his credit at all times will inspire confidence very quickly. Rather than divide up plant profits, it is the best kind of good judgment to build up a formidable surplus.



The Shaded Portions Represent Capital Actually Available for Each Purpose in a Typical Case. The entire diagram (shaded and open) Indicates Approximate Capital Which Should Have Been Provided for Each of These Uses

Recent surveys indicate that at least 80% of the block output of the United States is produced in less than 20% of the plants, indicating that the day of large and well financed factories is not only coming but has arrived. The "millionaire" list of manufacturers producing 1,000,000 or more block per year is growing rapidly. Nevertheless, it must be remembered that within the experience of the present active bankers many concrete products factories have foundered on financial seas. In spite of the phenomenal gains throughout the industry, and no matter how sound any present company may be, it is likely to encounter deep-rooted suspicion begotten by the mistakes of the past.

The greatest need of the concrete products industry today is financial solidarity. It is to this industry what a good fly-wheel is to an engine.

Gardens and Garden Accessories

Wayside Gardens, 7645 Woodward Avenue, Detroit, combine an interesting line. They have issued circulars on Artcrete Products (made in Philadelphia) for home, garden or conservatory. They offer a complete garden service, including designs by a landscape architect. In the Artcrete line they offer pots, vases, panels, statues, pedestals, sun dials, fountains, bird baths, balustrades, porch boxes, lawn tables, gazing globes, garden benches, columns and caps—all made with white cement, with crushed white marble or granite. Some products are given an antique finish. In addition to the Artcrete, the Wayside Gardens sell trees, shrubs, perennial plants, bulbs, flowers, ferns, fruit trees, pergolas, trellises, flagstones, fertilizers, garden implements, window boxes, insecticides, pottery and bird houses.

Thickness of Block Walls

A 13½-in. thickness for concrete block walls as specified in proposed building regulations brought to CONCRETE's attention recently by correspondence would work a considerable hardship and accomplish no practical good. Thicknesses are usually based on brick wall requirements.

Table 3 of the Report of the Building Code Committee, Bureau of Standards, Washington, D. C., lists requirements for solid exterior walls of dwellings within or outside of fire limits as follows: one-story 8 in., 12 in., 17 in.; two-story 8 in., 12 in., 16 in.; three-story 8 in., 12 in., 16 in., 20 in.; four-story 8 in., 12 in., 16 in., 20 in., 24 in. This summary is compiled from the examination of 134 building codes, from all parts of the country. Fifty-five codes, or about 41% of the number, permit the construction of two-story dwellings with 8-in. exterior walls (solid). The average permits allow walls to be 27 ft. high. Six codes allow three-story dwellings with 8-in solid walls having an average height of 35 ft. and 13 permit the upper two stories of three-story dwellings to be 8-in thick.

A search by the Brick Manufacturers Association of America shows that of 113 codes examined 44 or about 39% permit two-story dwellings with 8-in. brick walls and eight permit three-story dwellings of this type.

In each code the requirements refer to the construction both within and outside of congested districts, and represent the minimum in allowable thickness for solid exterior brick walls.

City building codes do not in general provide for the construction of concrete houses of all types. These codes usually contain a table of wall thicknesses, but these refer only to masonry walls composed of units laid with mortar joints. Often the units for such walls are enumerated, including brick, tile, concrete block, etc. Some codes refer to brick only.

Quoting further from the Bureau of Standards Report above mentioned, section 8 of article 3, page 14, states: "The minimum thickness of exterior walls built of hollow building tile, hollow concrete block or hollow walls of brick shall be 8 in. for uppermost 20 ft. The total height shall be limited to 30 ft., etc."

Further, under section 28 of article 7, page 21: "The minimum thickness of party or division walls of hollow built tile or hollow concrete block or of hollow wall construction shall be 12 in., etc."

With the inclusion of the width of mortar joints in the customary 12-in. brick wall construction, overall dimensions in width will approximate the 13½-in. referred to in the proposed requirement. Exception should be made, however, for very practical considerations.

The usual recommended allowable unit compressive stresses (lbs. per sq. in.) in masonry laid in portland cement mortar are as follows:

Clay or Sand-Lime Brick, Standard Common (crushing strength 1800 lbs. per sq. in.)	175
Clay or Sand-Lime Brick, hard or select (crushing strength 3000 lbs. per sq. in.	270
Concrete Brick (crushing strength 1500 lbs. per sq. in.)	200
Hollow Concrete Block or Tile or Hollow Clay Tile (on gross area)	90
Solid Concrete Block	150
Rubblestone Work	150
Cut-Stone Masonry (other than Sandstone)	400
Sand Stone Masonry	300

Road Building

Roadbuilding belongs close to the top in the list of big businesses in the United States. The latest estimate compiled by Thomas H. MacDonald, Chief of the United States Bureau of Public Roads, shows that during 1923 approximately 40,000 mi. of surfaced roads will be completed. The 1922 construction program approximated 37,000 mi. divided as follows: 6,000 mi. of pavement, such as brick, concrete, sheet asphalt and bituminous concrete; 4,000 mi. of macadam, waterbound and bituminous; 20,000 mi. of gravel and 7,000 mi. of sand-clay and top-soil roads. The classification of this year's 40,000 mi. will be about the same.

At the beginning of this year, there were about 400,000 mi. of improved surfaced roads in existence, and at the present rate of progress this mileage will be doubled in ten years.

One of the most important factors in the great movement for more and better roads, which has resulted in the construction of improved highways at the rate of 40,000 mi. a year, is the American Road Builders' Association, which was organized more than twenty years ago and which holds an annual convention and road show. The 1924 convention and show will be held in Chicago, the convention at the Congress Hotel and the show at the Coliseum from January 14 to 18 inclusive.

Organizations

American Concrete Institute; Harvey Whipple, Secretary, 1807 East Grand Boulevard, Detroit. Convention February 25 to 28, incl., 1924, Drake Hotel, Chicago.

American Concrete Pipe Association; M. W. Loving, Secretary, 111 West Washington St., Chicago. January 17-19, Sherman Hotel, Chicago.

American Engineering Standards Commission; Dr. P. G. Agnew, Secretary, 29 W. Thirty-ninth Street, New York City.

Associated General Contractors of America; G. W. Buchholz, Secretary, 1038 Munsey Bldg., Washington, D. C. January 21-23, Chicago.

Associated Metal Lath Manufacturers; 123 W. Madison St., Chicago; Wharton Clay, Commissioner.

Building Officials Conference; Rudolph P. Miller, President, Fred W. Lumis, City Hall, Springfield, Mass., Secretary.

Iowa Cement Stave Silo Association; H. E. Kilmer, Secretary, Oskaloosa, Ia.

Iowa Concrete Products Association; Ross Dowell, Secretary, 405 Hubbell Bldg., Des Moines.

Mid-West Concrete Products Association; D. R. Donlen, Secretary-Treasurer, 4340 Marcy St., Omaha, Neb.

National Association of Manufacturers; John E. Edgerton, President; Henry Abbott, Treasurer; George S. Boudinot, Secretary, 50 Church St., New York City.

The National Concrete Stave Silo Association; W. G. Kaiser, Secretary, 111 West Washington St., Chicago.

National Crushed Stone Association; A. P. Sandles, Secretary, 405 Hartman Bldg., Columbus, Ohio.

National Housing Association; Lawrence Veiller, Secretary and Director, 105 East 22nd St., N. Y. C.

The National Lime Association; Mather Bldg., Washington, D. C.

National Sand and Gravel Producers' Association; T. R. Borrows, Acting Secretary, 903 Munsey Bldg., Washington, D. C.

Portland Cement Association; William M. Kinney, General Manager, 111 West Washington Street, Chicago.

Wisconsin Concrete Products Association; D. R. Collins, Secretary-Treasurer, Milwaukee.